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OBITUARY.

SIR JOHN ANDERSON, G.C.M.G., K.C.B., LL.D.

It is with the deepest regret that we have to record the death on March 24th of SIR JOHN ANDERSON, G.C.M.G., K.C.B., LL.D., Governor and Commander-in-Chief in and over the Island of Ceylon, with the Dependencies thereof.

SIR JOHN ANDERSON assumed the administration of the Colony on April 15th, 1916, and throughout has taken the greatest interest in its agricultural industries. As President of the Agricultural Society he has presided over meetings of the Board of Agriculture and the Society.

His first association with the Board was at its Annual General Meeting held on June 6th, 1916, when it was decided to appoint a Committee to enquire into the question of Land Development under the Irrigation Tanks in the Dry Zone of the Colony. The report of this Committee recommending a trial settlement in the North-Central Province was favourably considered and funds promised at an early date.

His Excellency was also interested in the paddy cultivation of the Colony and anxious to encourage the production of better crops by means of seed selection, transplanting and manuring. He was solicitous for the welfare of the small grower, and for the spread of the co-operative credit movement.

His sympathetic guidance will be missed and his loss to the Colony and to the Empire will be mourned by all members of the Ceylon Board of Agriculture and its Agricultural Society.

EDITORIAL.

THE VALUE OF AGRICULTURAL SHOWS.

The value of Agricultural Shows has been discussed in detail in many countries and many varied opinions have been expressed. All are agreed however, that if properly arranged, these shows afford useful lessons of an educational value and encourage a spirit of healthy competition amongst the agriculturists.

To be of real educational value, shows must be organized and must be held at regular and definite intervals. Agricultural shows which are held only at irregular intervals of time do not serve any purpose beyond catering for the pleasure-seeking of visitors.

While amusements serve as an attraction to visitors, it must not be overlooked that the real value of an Agricultural Show is to be seen only in the pavilions provided for the exhibits. It is here that useful comparisons of exhibits can be made, and useful hints on the cultivation and the varieties of crops gained. These exhibits must be systematically arranged and in the exhibition of agricultural produce there are details that have to receive the attention of the Show Committees as well as of the exhibitors themselves.

During the past month, a beginning has been made with this year's agricultural shows and brief accounts of three of such shows are given in the present issue.

These shows are village shows and have been organized by Chief Headmen through Co-operative Credit Societies. They are limited in their areas of operations, in the hope that exhibits have been produced by the exhibitors upon land near to the centre in which the show is held.

They have been organized mainly with a view to demonstrating the variety and the quality of vegetable produce that can be grown in the various districts of the colony, and visitors to those shows already held have testified to the interest taken in them by the small cultivator and to the excellence of much of the produce grown.

These shows have shown that our main food products, vegetables and curry stuffs can be readily grown locally and it is to be hoped that they will serve as a further stimulus to the planting of further areas with these products with the South-West Monsoon season shortly to commence.

THE PADDY PAVILION.
Beligammana Agricultural Show, 1918.

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CEYLON AGRICULTURE.

AGRICULTURAL SHOWS.

THE BELIGAMMANA VILLAGE SHOW.

Village shows were some years ago held with more or less regularity in different districts—notably in the Kalutara district, where the encouragement they afforded to cultivators was very marked.

Of recent years, and particularly since the beginning of the war, there have been very few fixtures, and except the annual exhibition held in Nuwara-Eliya no shows have been held in any part of the Island.

The necessity for giving an impetus to the cultivation of food-crops at the present juncture is no doubt responsible for the revival of interest in village shows, and the Organising Vice-President in a memo. submitted to the Board of Agriculture brought out this fact and suggested that the initiative should be taken by Co-operative societies.

The Agricultural Society supported the proposal by offering grants in aid, and up to date no less than 10 shows are on the cards.

To Kegalle district must be given the credit of being first in the field. Five shows have been arranged for this area, the first of which was held at Beligammana (just below the Kadugannawa Pass on the Colombo-Kandy road) on the 25th and 26th February. The Assistant Government Agent, Kegalle, opened the show on the afternoon of the 1st day in the presence of the chief residents of Kegalle and a number of planters of neighbouring estates. On the first day the Agricultural Society and Department were represented by the Secretary of the Society and the Superintendent of Botanic Gardens.

The Director of Agriculture (Organising Vice-President of the Society), who was unavoidably kept away by other pressing engagements on the opening day, made a point of inspecting the exhibits on the second day.

Boyagoda Ratemahatmaya who was the organiser of the show was assisted by Messrs N. Wickramaratne (Secretary, Board of Control, Co-operative Credit Societies) W. Molegode (Senior Agricultural Instructor), and C. P. Crispeyn (Agricultural Instructor of the district), as well as Mr. Alex. Perera, Inspector of School Gardens, whose report on the show is given below:

"This Agricultural Show was the first of a series of village Shows held in Kegalle district under the auspices of the Co-operative Credit Societies scheme to encourage the increased production of food and curry stuffs in the country. The venue of the show was the temple grounds of Beligammana, a hamlet about a mile from Mawanella, and it was organised by Mr. H. W. Boyagoda, the Ratemahatmaya of Galboda and Kinigoda Korales. A special feature of this show was the leading part taken by the teachers and pupils of both boys' and girls' schools with school gardens who brought in large numbers of exhibits grown or produced, for the most part, by themselves.

"In the vegetable section, chillies and capsicums were specially well represented. Cucumbers, pumpkins, snake- bitter- and bottle-gourds of

good quality were to be seen. Beans of various kinds, mè, brinjal and okra were well represented. Radish, luffa, and collections of herbs were fair. Tomato and bread-fruit were of poor quality. Curry plantain should have made a better show.

"The fruit section was only fair as was to be expected, considering the time of the year. The few mangos exhibited were green, and only a few samples of oranges were good, whilst mandarins were badly represented. The collection of limes was large and of fair average quality, and the collection of pumeloes good. A number of Kew pines were shown as well as Mauritius pines, but the quality was not very high. A good collection of bael fruits was to be seen. A few good papaws were also shown. Pomegranate, anona, and jambu were poor, whilst eating plantains were disappointing. Very good samples of jak were exhibited.

"*Yams.*—The collection of yams was remarkably large and good. Quantities of manioc, yams and innala were shown and there were many good specimens of these, as well as edible canna, arrow root, sweet-potatos, king yam, engili ala, hingurala, etc.,

"In the economic products section, large collections of arecanuts and coconuts were exhibited. Ginger, turmeric, onions, betel, paddy and kurakkan were well represented—as also green-gram, kollu and gingelly. Specimens of Indian corn and dhurra were seen, also a few collections of chena products.

"Prepared products consisted of Oils—coconut, gingelly, na, kekuna, mi, and a collection of medicinal oils. Flour prepared from rice, kurakkan, kitul, arrow-root, manioc and plantain were exhibited, as well as ghee, dried garcinia, nutmeg and mace, clove, cardamoms, black and white pepper, mustard, cinnamon and a few specimens of curry stuffs locally produced.

"Small collections of fibres of kitul, coconut, sanziviera were exhibited. Some samples of cotton and kapok were also shown and an interesting collection of manufactures by Rodiyas such as, brooms, ropes, etc. Among prepared products were jams and jellies, pickles and chutneys, honey and sweet meats.

"Manufactured articles consisted of agricultural implements locally made, viz, Mamoties, katties, knives etc., the workmanship of which was very fair. There were some samples of wood carvings and a few good samples of ivory carvings and silver Kandyan art work. A few neat specimens of pots and pans may be mentioned, as well as good pieces of needle work.

"The live stock section consisted of some native and cross-bred cattle, a few goats, pea fowl and pigeons.

"Prizes were awarded to the best School gardens, Villagers' gardens in the district, and Home gardens of school children.

"There were competitions among the Kandyan dancers and recitations by school children.

"The school treat on the 2nd day consisted of viewing the show, followed by breakfast to over 1,400 boys and girls. Then came competition recitation, drill and sports followed by tea and the awarding of prizes.

It is needless to say that the show was a success, far beyond the expectations of those who organised it and those who visited it."

C. DRIEBERG.

THE SHOW PAVILIONS.

Beligammana Agricultural Show, 1918.

MAWATUGODA AGRICULTURAL SHOW.

This Agricultural Show, held on the 16th and 17th of March, at the village of Mawatugoda (Aranayake) was the third of the series of shows organised by the Co-operative Credit Societies of the Kegalle district—the first two being held at Beligammana and Ruanwella.

The grounds and some of the wards of the fine newly constructed Aranayake Hospital were kindly lent for the occasion by the Director of Public Works, and Mr. M. B. Mapitigama Ratemahatmeya of Parana Kuru Korale and his headmen to whose energy the successful working of the show was due, decorated both grounds and buildings in Kandyan style.

The Assistant Government Agent of Kegalle (Mr. G. F. R. Browning) formally opened the show in the afternoon of the 16th and a large number of visitors from Kegalle and the neighbouring estates were present.

There were over 2,500 exhibits so that the display was from the point of numbers decidedly good.

The vegetable section was on the whole good. Brinjals, Snake and Bitter gourds, beans, chillies and cowpeas and luffa were of the average quality. Two specimens of Capsicums grown in pots made a striking exhibit, Okra, onion and tomatos were very fair. Very good khol-rabi and turnip grown in the School Garden were exhibited. Cucumbers, pumpkins and jak were of average quality. A good collection of curry plantains was to be seen.

Yams. The collection of yams was not very large, but very good specimens of King yam, Kidâran, Engili-ala and very fair samples of Manioc, Sweet potato, Coco yam, ginger, turmeric, etc., were exhibited.

School Gardens. Mawatugoda School had not only the best garden, but the best and largest collection of vegetables, both from the school gardens and home gardens. Rosella, Hettimulla and Kehelwatte School Gardens also sent good collections of vegetables. Boys of most of the schools in the neighbourhood brought in individually a large number of vegetables and fruit, etc., which swelled the number of exhibits.

There was a very large collection of Kew pines in the fruit section of fair average quality; also a few Mauritius and Sugar-loaf pines. All the mangos and most of the oranges were unripe, but there was one good sample each of sweet oranges and mandarins. Pumelos were not up to standard, but a large collection of limes were exhibited. A few good specimens of papaw were shown and there was a good collection of Bael fruit and plantains; the latter, however, were not ripe.

In the section for Economic Products, big collections of locally grown paddy and rice were exhibited and very good specimens of coconuts (husked and unhusked) and fine collections of arecanuts. Sugar cane of good length grown in villages and very fair exhibits of Indian Corn and Dhurra were to be seen. Curry stuffs were represented by well grown coriander, dried chillies, aniseed, white and black pepper. Collections of kurakkan, amu, kollu and menèris represented chena products. A few cacao beans and pods were also to be seen. Prepared products consisted of a good collection of oils (coconut, king coconut, gingelly, mi, kekuna and medicinal), and flour prepared from rice, kurakkan, kitul, madu, manioc and arrowroot. There were very fair specimens of cotton and fibres and good exhibits of papain.

A few samples of good copra were to be seen and also an exhibit of coconut poonac. A fair collection of preserved pickles and native sweets were exhibited.

The collection of industrial products was very large and varied and some of the exhibits were of very good workmanship; also carved and inlaid

wood-work of various designs, brass, silver and ivory carvings. A large number of ancient Kandyan articles, models of garden and field implements, samples of pottery, brick and tiles were exhibited. A good collection of needle work was also sent in.

The Rodiyas had a booth to themselves where they exhibited well finished brooms and switches, ropes of hide and fibres, walking sticks, etc.

The live stock section was represented by some country and cross-bred cattle, a few buffaloes and goats, some poultry, pigeons and peafowl.

At the end of the first day there was a competition in Kandyan dancing while on the following day all the school children in the district after viewing the show were provided with breakfast and afterwards they indulged in sports and took part in songs and recitations for which prizes were offered, ending up with tea. The distribution of awards by the Assistant Government Agent and MAPITIGAMA KUMARIHAMY brought the show to a close.

The Officers of the Agricultural Department who were present at the show were the Director of Agriculture, Messrs. N. WICKRAMARATNE, W. MOLEGODE, C. CRISPEYN and myself; all of whom helped in various ways. The members of the Kegalle Kachcheri staff and a number of ladies and gentlemen were also of considerable assistance in receiving, arranging and judging the exhibits.

ALEX. PERERA.

RUANWELLA SHOW.

Fruits.—Considering the season, this section was not badly represented. Kew pines were particularly fine specimens. The two prize fruits weighed 19 and 16 lb. Oranges were of good quality but not many were shown. Other satisfactory kinds were jak and table plantains.

Vegetables.—Brinjals and Chillies exceptionally fine. Snake gourd, bitter gourd and bottle gourd excellent. Good specimens of luffa and bandakka but over-ripe. Pumpkin should have been better. Cabbage (without heads), turnip, tomato, carrot and radish showed what can be produced with careful cultivation. Dwarf beans were not up to standard: long beans much better. Curry plantains and pumpkins should have been better. A good show of cucumber and kekiri.

Tuberous crops.—A very good show. Sweet potatos, innala, cassava, yams, and tanias were well represented. Good specimens of arrowroot and edible canna.

Cereals and Pulses.—Another good section. Exhibits of paddy were clean and fairly numerous. The prize rice was particularly fine. Among dry grains amu, menèri and maize were shown. Green gram was absent. There was a good specimen of local dhall.

Currystuffs.—Coriander and anise (grown for the first time), onions, ginger and turmeric were all good. Mustard and pepper were also shown.

Miscellaneous products.—Some fine specimens of coconuts were shown. Arecanuts particularly good. Betel and sugar cane poor. Among fibres 2 or 3 fine specimens of cotton were sent in.

School Garden Exhibits.—There should have been better competition. The prize was awarded to Ruanwella School garden. A striking feature was the large display of exhibits from Home gardens—over 200 in number. I judged these myself and awarded 10 well deserved prizes.

C. DRIEBERG

COMMITTEE OF AGRICULTURAL EXPERIMENTS.

Minutes of a meeting of the Committee of Agricultural Experiments held at the Peradeniya Experiment Station, on Thursday March 7, 1918.

Present :—The Director of Agriculture (Chairman), the Botanist and Mycologist, the Acting Entomologist, Messrs. N. K. Jardine (Entomologist for Tea Tortrix), J. S. Patterson, M. L. Wilkins, T. Y. Wright, A. E. de S. Rajapakse, Mudaliyar, A. W. Beven, C. E. G. Panditteseкera, N. G. Campbell, E. W. Keith, H. D. Garrick, R. G. Coombe, A. J. Austin Dickson, and H. A. Deutrom (Acting Secretary), and as visitors, Messrs. W. H. Biddulph, L. C. Maudslay, J. Forsyth, E. G. Beilby, and T. Finch Noyes.

The minutes of the previous meeting having been confirmed, the Chairman stated that letters had been received from the Hon. the Government Agent, C.P., the Assistant Government Agent, Puttalam, Messrs. J. Graeme Sinclair, G. H. Golledge, G. H, Masefield, J. B. Coles, A. S. Long-Price, and a telegram from the Hon'ble Mr. Huyshe Eliot, regretting their inability to attend the meeting. He had also received a letter from Lt.-Col. W. G. B. Dickson, tendering his resignation, as it was not possible for him to attend meetings regularly, owing to great increase of military work, caused by compulsory training, and other work. It was, however, decided that he should be asked to remain on the Committee and to attend such meetings as is possible while compulsory military service is continued.

Mr. A. W. Beven suggested the name of Sir Solomon Dias Bandaranaika to fill the vacancy caused by Mudaliyar A. E. de S. Rajapakse, who becomes an ex-officio member of the Committee having been appointed Chairman of the Low Country Products Association. It was resolved to recommend to Government that the Maha Mudaliyar be nominated to fill this vacancy.

2. *Progress Reports.*—The Chairman explained that the Progress Reports of the Experiment Stations had not been prepared for this meeting, the period covered being only a month.

3. *Yields of Tea plots, Peradeniya, 1915-1917.*—The Chairman in the absence of Mr. Bamber explained the figures on the statements circulated, and called for comment. He drew attention to the high yields of the dadap plots.

Mr. R. G. Coombe enquired whether any information was available with regard to the manurial experiments carried out at Portswood and Dessford Estates. He was of opinion that records of higher elevations would be of considerable value. The Chairman thereupon undertook to make the necessary enquiries.

It was decided to make another complete census of the actual number of bushes in each plot at Peradeniya at an early date.

4. *Results of Rubber Tapping Experiments at Henaratgoda and Peradeniyà.*—The Botanist and Mycologist gave a summary of the rubber tapping experiments at Henaratgoda and Peradeniya.

At Henaratgoda, the yields from two cuts and one cut had been compared. The cuts were placed on opposite sides of the same tree, one cut on a quarter on one side and two cuts on a quarter on the opposite side. In one series the two cuts were one foot apart, and in the other series two feet apart. The yields of the upper cut on the two-cut side gave about half as much as the lower in each case, but does not appear to have had any appreciable, if any, effect upon the yield of the lower cut.

At Peradeniya the previous experiments had been continued. In the time-interval experiment, the yields for 1917 had been 5·9 pounds per tree in alternate day tapping, 5 pounds in three-day tapping, and 2·4 pounds in weekly tapping. In the "change-over" tapping the double tapping at the time of change was given up in 1917; the yields from the single cut on one quarter still showed an advantage in changing over, but those from the V cut on one half did not. In the experiment with a V cut on one-third compared with a single cut to the left on one-third, the yields for three and a half years showed no difference. An experimental tapping of renewed bark of different ages $5\frac{1}{4}$, $4\frac{2}{3}$, and $3\frac{1}{2}$ years old, respectively, at the beginning of the experiment, the yields for 18 months from a single cut on one-third, tapped on alternate days were very close for the two younger barks, but nearly 30 per cent. greater from the oldest. The ratio was as 18 : 15 : 13. It was also mentioned that the increase in thickness of the renewed bark between the $4\frac{2}{3}$ years bark and the $5\frac{3}{4}$ year old bark had not been very great.

A general discussion took place and it was finally decided to publish the results in bulletin form and to issue a summary in the Tropical Agriculturist.

Several suggestions were made as to further tapping experiments at Peradeniya, and the Chairman undertook to report to the Committee, at its next meeting, the actual number of trees which were available for such experiments.

5. *Time intervals in rubber tapping.*—Messrs. Wilkins and Patterson brought up the question of the relative merits of daily, alternate-day and three-day tapping. It was suggested that another time-interval experiment should be instituted with a single cut only, and it was agreed that this should be done if the required number of trees was available.

6. *Use of liquid fuel on tapped surfaces as a preventive of bark rot.*—Mr. J. S Patterson stated that several estates were using liquid fuel on tapped surfaces for the prevention of bark rot, and enquired whether its application had any injurious effect on the tree.

The Botanist and Mycologist stated that experiments to ascertain the effect of various preventatives on renewing bark had been carried out with

coal tar and liquid fuel, and mixtures of these in the proportion of eighty per cent. coal tar and twenty per cent. liquid fuel, fifty per cent. coal tar and fifty per cent. liquid fuel, and twenty per cent. coal tar and eighty per cent. liquid uel. In no case had any wound or exudation of latex been caused. The renewing bark on the cut in these experiments was usually 1·5 millimetres thick. On estates, however, he had seen exudation of latex after the application of tar and liquid fuel, and tar and tallow, not only on the youngest bark but up to four inches above the cut. In many instances this occurred at the edge of a wound, but in others there was no wound. The cause of this had not yet been ascertained. It appeared to occur more generally in the dry weather, but it had not happened on trees on the Experiment Station to which pure coal tar, pure liquid fuel, and the fifty per cent. mixture had been applied when the trees were leafless, after a period of drought extending over five weeks. He would advise that these mixtures should not be applied during the dry season, but immediately before the rains.

7. *Borers on tapped surfaces of rubber.*—Mr. Speyer gave information concerning Rubber Borers and said that he had 56 records since 1903, of which 31 showed that the various species of Scolytid borers had entered trees or parts of trees already killed by fungi. A further 11 records were from dead and decaying wood. There was no record of successful attack in healthy trees or healthy portions of trees. In the recent reports of these borers in tapped and untapped surfaces treated with tar and liquid fuel, it is probable that the borers are attracted to small diseased patches, and in no case had the beetles been able to pass the latex layers. There can be no doubt that the attack, though ending in death of the beetles which are drowned in the latex on entry, is most unsatisfactory, and the remedy is to be found, not in ceasing the application of preservatives, but in removing the source from which the beetles originate, namely dead rubber-wood. Surfaces treated with preservatives of various kinds in the Peradeniya experiment plots show no signs of beetle attack, and the absence of beetles in scars points to the fact that there are no beetles in the vicinity to make the attack. This is due to the early removal and destruction of dead trees and branches.

Several specimens of dead rubber trunks sent in recently by Superintendents of Estates had beetles emerging from them, so that the wood must have been dead at least two months to give time for the development of the broods.

The remedy for the trouble is therefore the early and quick removal of all dead trees and portions of trees, and their immediate destruction by fire.

8. *Results of experiments in manuring rubber at Peradeniya for 1917.*—The Chairman explained the figures in the statements circulated. The highest yields had been obtained where excess of phosphoric acid had been given, while the plots with the lowest yields were those receiving excess of potash and the mineral mixture. These plots had however not been thinned

and therefore a comparison of the figures was not really satisfactory. It was resolved to thin out the plot of rubber manured with excess of potash, at an early date. It was stated that the manure has been applied in trenches with leaves, between the rows of trees. The results of these experiments not having been published for the last three years, it was decided that this should be done in bulletin form.

9. *Results of Experiments with coconuts.*—The Chairman stated that the figures of the various experiments had been tabulated and circulated up to the end of the year 1917. He passed round charts showing increase and decrease in yields from 1914 to 1917. He said that at Pitiakande continued increases in yields had been obtained on those plots which (1) had been cultivated monthly and (2) had been treated with cattle manure. At Chilaw, half the plots had shown satisfactory progress but those on the sandy soils had not done well in 1917. On the heavier land the best yields were being obtained from the plot which was cultivated every month. At Negombo, the most marked increase during the year has also been made on the plot which has been regularly cultivated. At Maha Iluppalama the coconut crops had increased during the year—those receiving irrigation gave an average of 25·8 nuts per palm and those which were not irrigated an average of 9·8 nuts.

Mr. Patterson pointed out that 10 tons of lime was excessive, and Mr. A. W. Beven was also of the same opinion.

Mr. Beven suggested that from next year the lime should be omitted from Plot No. 8 in the Chilaw experiments, and that 10 cwt. of lime be applied to another plot. The Chairman promised to consider the matter.

It was resolved to publish all details of the Coconut Experiments in the Tropical Agriculturist.

10. Mudaliyar A. E. Rajapakse explained certain experiments he was conducting at Negombo to determine the fertility of a coconut land, and how its productivity could be maintained if its products be returned to the soil, the droppings including the water, leaves, shells, and one-third of the weight of copra and poonac, being returned once a year.

The Chairman stated that the figures would be useful to ascertain the quantity returned into the land from what had been actually taken out of it.

The Chairman tendered his apologies for the long agenda, but he had taken the earliest opportunity of presenting the latest figures of the various experiments being carried out by the Department.

11. Mr. H. D. Garrick enquired about the latrines built by the Public Works Department for coolies of the Experiment Station, Peradeniya, which were recently inspected by the Committee.

The Chairman stated that they were reported to be of the type plan, and had recently been inspected by Public Works Officers.

CEYLON AGRICULTURAL SOCIETY.

Minutes of Proceedings of a meeting of the Agricultural Society, held on the 25th February, 1918.

The first meeting of the Society for the year 1918 was held at the Council Chamber, Colombo, at 12·30 p.m. on Monday the 25th February, 1918.

The Hon'ble the Colonial Secretary presided.

There were also present :—Sir S. C. Obeyesekere, Sir Solomon Dias Bandaranaike, The Hon'ble Messrs. Harry Creasy, O. C. Tillekeratne, K. Balasingham, Dr. H. M. Fernando, The Director of Agriculture, Superintendent of Royal Botanic Gardens, Lt. Col. T. G. Jayawardene, Dunuwile Disava, Mudaliyars J. A. Wirasinghe and A. E. Rajapakse, Maniagar V. M. Muttukumaru, Messrs. W. A. de Silva, Gerard Joseph, G. W. Sturgess, A. W. Beven, F. L. Daniel, A. Bruce, R. M. Fernando, H. A. Deutrom, J. S. de Silva, M. J. A. Karunanayake, J. C. Drieberg, L. de Z. Jayatilleke, E. Shelton Storer, J. G. Tennekoon, R. M., Dr. Gerald de Saram, Mr. James Peiris, Mr. C. Drieberg (Secretary).

Minutes of the previous meeting held on the 26th November, 1917, were read and confirmed.

Progress report was adopted on the proposal of the Chairman and seconded by Sir Solomon Dias Bandaranaike, as was the Statement of Expenditure to the end of December, 1917, proposed by the Director of Agriculture and seconded by Mr. Joseph.

Estimates of revenue and expenditure for 1918 were adopted on the motion of the Director seconded by Hon'ble Dr. H. M. Fernando.

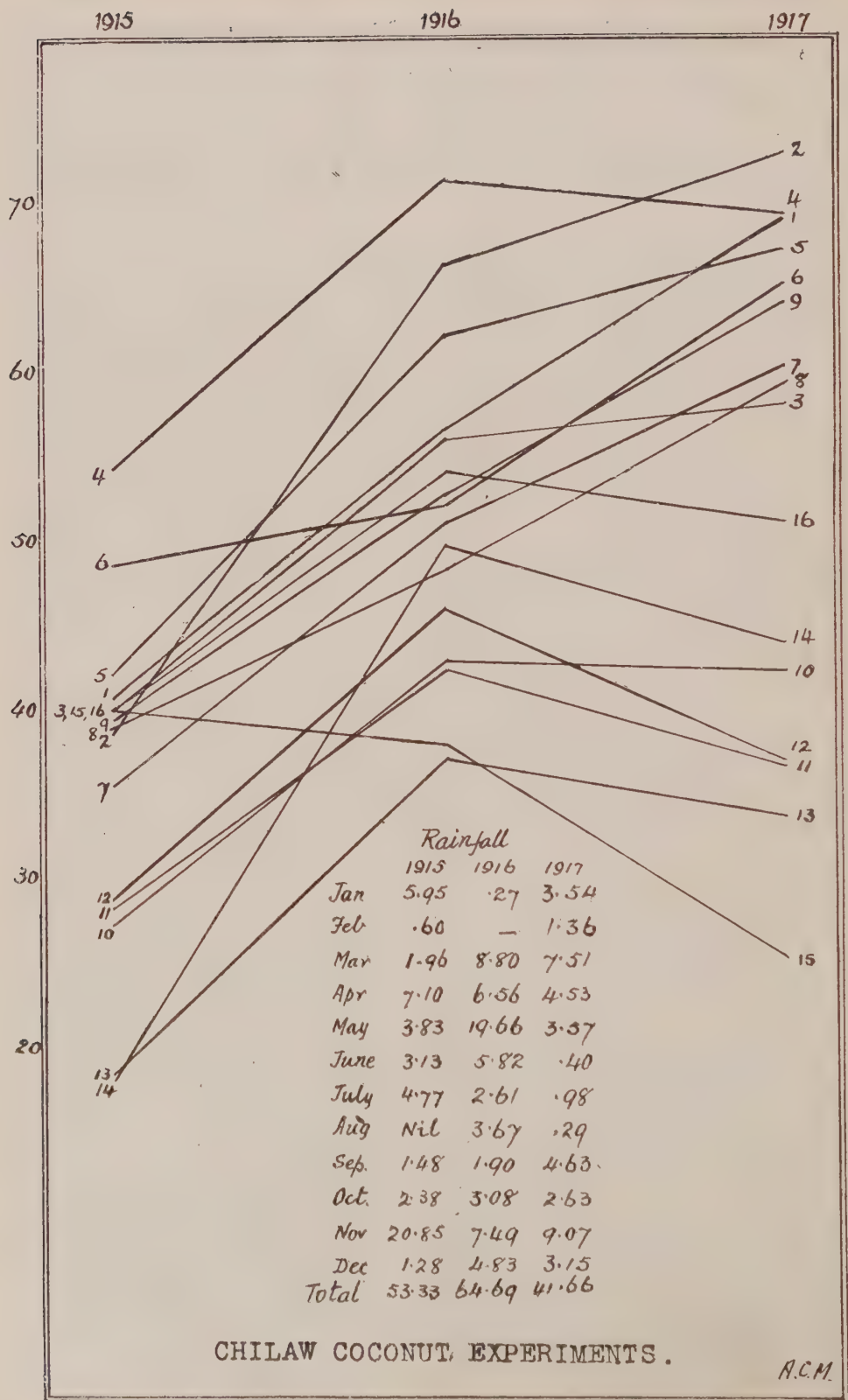
The Secretary read letter from Government dated December 18th in reply to the report on the Land Development Scheme, offering the sum of Rs. 20,000 in connection with the Nachchaduwa peasant settlement. On the motion of the Director of Agriculture, seconded by Sir Bandaranaike it was agreed that the Board acknowledge the offer of Government and express their appreciation of this sympathetic treatment of the report.

The Proposals for Co-ordination and Extension of Agricultural Services by the Director of Agriculture were next taken up. The various details that should receive consideration by the Board were explained by the Director in some introductory remarks. Mr. Sturgess read a memorandum urging for a more comprehensive scheme to include not only agriculture but also commerce and industry. After discussion, Lt.-Col. Jayawardene proposed that proposals be submitted to a Special Committee of the Board. This was seconded by Mr. Joseph and adopted, the following Committee being appointed :—Hon'ble Mr. P. Ramanathan, Mudaliyar A. E. Rajapakse, Hon. Dr. H. M. Fernando, Messrs. A. W. Beven, W. A. de Silva, H. L. De Mel, Hon. Mr. A. Sabapathy, Hon. Mr. O. C. Tillekeratne and Dunuwile Disava with the Director of Agriculture and Secretary, C.A.S.

Dr. Fernando said that the congratulations of the Board were due to the Director of Agriculture for the proposals submitted.

The report of the Committee appointed to consider the establishment of Experiment Stations in the Northern Province was then dealt with, Hon. Dr. Fernando and Mr. de Silva offered remarks regarding the standard of education test suggested. The Director spoke on the standard required at the School of Agriculture at Peradeniya for the present courses and reviewed the work that was being accomplished. On the motion of the Director and seconded by Mr. G. Joseph the report was adopted and it was decided to forward it to Government for consideration.

This concluded the business of the meeting which dispersed at 2 p.m.



Rainfall

	1915	1916	1917
Jan	5.95	.27	3.54
Feb	.60	—	1.36
Mar	1.96	8.80	7.51
Apr	7.10	6.56	4.53
May	3.83	19.66	3.37
June	3.13	5.82	.40
July	4.77	2.61	.98
Aug	Nil	3.67	.29
Sep.	1.48	1.90	4.63
Oct.	2.38	3.08	2.63
Nov	20.85	7.49	9.07
Dec	1.28	4.83	3.15
Total	53.33	64.69	41.66

CHILAW COCONUT EXPERIMENTS.

A.C.M.

COCONUTS.

COCONUT EXPERIMENTS IN CEYLON.

In the Tropical Agriculturist for April 1917 records were given of yields for 1916 of the experiments carried out at Chilaw and Pitiakande. The results for 1917 are tabulated below with such comparisons with previous years as are considered desirable. The results of trials at Negombo and Maha Iluppalama are also given. These results were all discussed at the meeting of the Committee of Agricultural Experiments held at Peradeniya on March 7th when it was resolved to publish all details of the coconut experiments in the Tropical Agriculturist.

STATEMENT OF RETURNS FROM CHILAW COCONUT EXPERIMENTS PLOTS.

Plot	No. of Palms	Treatment	1915		1916		1917	
			Yields	Yields per palm	Yields	Yields per palm	Yields	Yields per palm
1	47	Clean weeded	1931	41·1	2677	57·0	3262	69·2
2	72	Sulphate of Ammonia 2½ lb. per palm, 1915						
		Disc harrowed monthly, 1916, 1917	2804	38·9	4810	66·8	5267	73·1
3	89	Groundnut cake 6 lb. per palm, 1915						
		Crushed fish 6 lb. per palm, 1916, 1917	3581	40·2	5014	56·3	5217	58·6
4	81	Steamed bone meal 8 lb. per palm, 1915, 1916, 1917 ...	4429	54·7	5800	71·6	5648	69·7
5	84	Sulphate of potash 2¾ lb. per palm, 1915, 1916, 1917 ...	3542	42·2	5225	62·2	5690	67·7
6	78	Ammonium sulphate 4 lb. per palm, 1915, 1916, 1917 ...	3829	49·0	4074	52·2	5114	65·5
7	92	Mineral mixture 6 lb. per palm, 1915, 1916, 1917 ...	3304	35·9	4714	51·2	5585	60·7
8	68	Lime 10 tons per acre, 1916, 1917	2674	39·3	3306	48·6	4057	59·6
9	85	Mixed manure 10 lb. per palm, 1915, 1916, 1917 ...	3383	39·8	4499	52·9	5464	64·2
10	107	Mulched with husks in 1915						
		No treatment	2933	27·4	4616	43·1	4576	42·7
11	100	Mulched with husks in rings round palms	2861	28·6	4286	42·9	3713	37·1
12	101	Ploughed	2936	29·1	4691	46·4	3772	37·3
13	99	Ploughed and disced 1917	1859	18·7	3694	37·3	3384	34·1
14	46	Dug with mamoty and mulched with leaves	2338	18·4	2294	50·0	2054	44·6
15	81	Watered			3087	38·1	2094	25·8
16	59	No treatment (store etc.)	2373	40·2	3222	54·6	3055	51·7

Notes by Supervisor.—

Plots Nos. 1 to 10 are the portions that were originally good. Even now the portions adjoining these are good.

The soil in plots Nos. 11, 12, 13, & 14 is of course sand and has no body in it. No. 15 requires something more than irrigating. I do not consider Ring mulching (No. 11) any good unless the soil round the trees is yearly tilled and then mulched. No. 16 is a part of No. 8 plot and is the same kind of soil but while the latter has had a good deal of lime the former has had none. I would suggest that the present treatment of blocks Nos. 11 & 16 should be abandoned and some other treatment resorted to.

Remarks.—

These results indicate improvement in yields on half the trial ground, the most satisfactory yield having been obtained from plot No. 2 which has received no manure since 1915 but has been disc cultivated monthly during the years 1916 and 1917. Plot No. 1—clean weeded—has also shown a satisfactory increase in crops. The poorer half of the field shows a fall off in yields but whether this is only temporary or not can only be ascertained after a further year's experiments. The lime plot No. 8 has shown satisfactory improvement and it has been decided to reduce the application to 10 cwt. per acre in future.

EXPERIMENT STATION, MAHA ILUPPALAMA.

CROP RETURN.

Plot A.				Plot B.			
Year	Total No. of trees	Total No. of nuts	Average nuts per tree in whole plantation	Year	Total No. of trees	Total No. of nuts	Average nuts per tree in whole plantation
1913 from March (10 months)	1224	3389	2·77	1913 from March (10 months)	449	253	·56
1914	1224	14222	11·60	1914	449	1229	2·70
1915	1224	21069	17·20	1915	449	1829	4·00
1916	1224	27132	22·20	1916	449	3150	7·00
1917	1224	31613	25·82	1917	449	4429	9·86

PITIAKANDE COCONUT EXPERIMENTS.

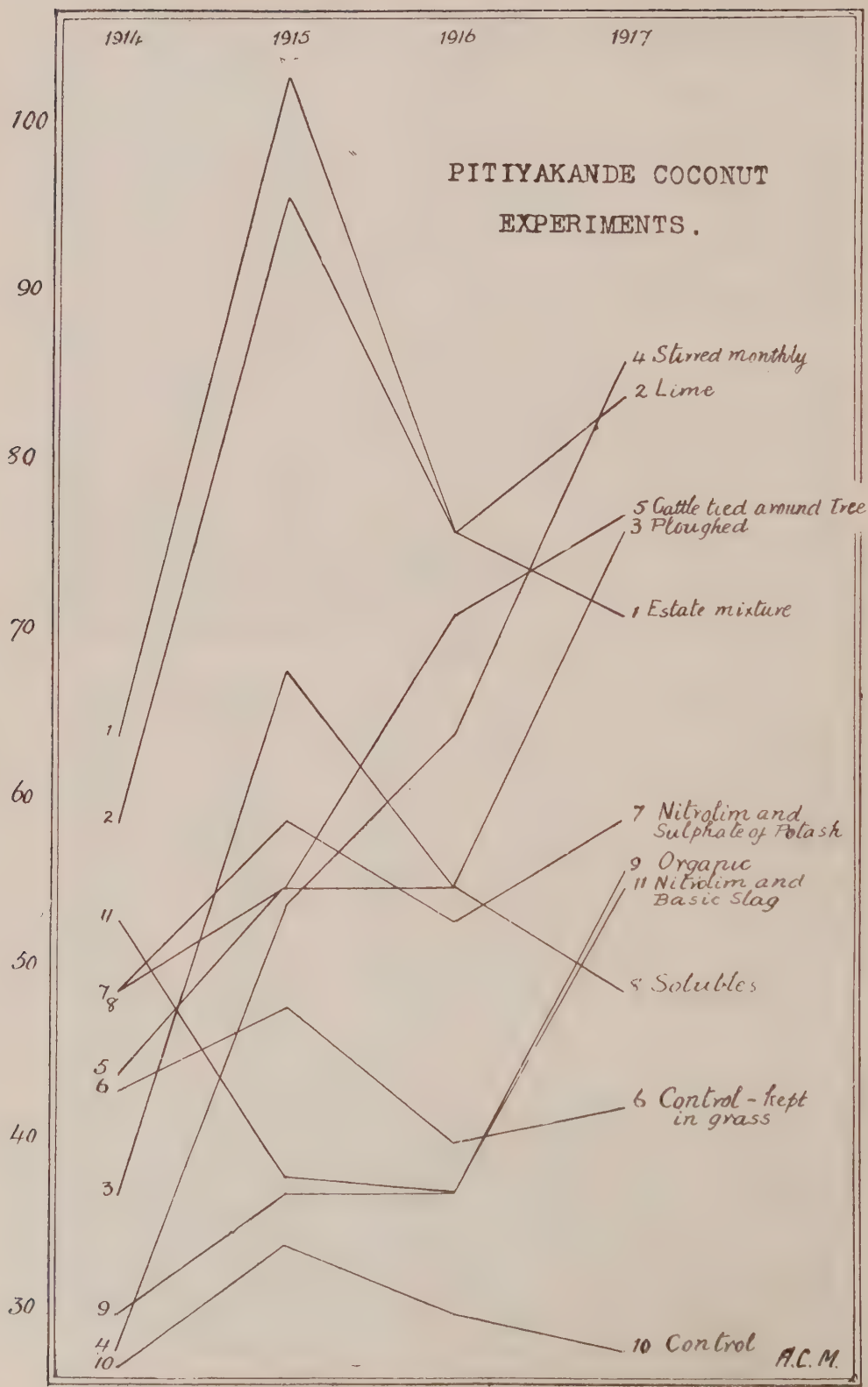
Plot Treatment	1917	Nuts per tree			
		1914	1915	1916	1917
1. Estate Mixture	No Manuring	64	103	76	71
2. Lime	Lime broad casted	59	96	76	84
3. Ploughed twice (yearly)	Ploughed with village plough	37	68	55	76
4. Soil stirred (monthly)	Clean weeded and stir soil	28	54	64	86
5. Cattle tied	Cattle tied round trees	44	55	71	77
6. Control (in grass)	Control (kept in grass)	43	48	40	42
7. Phosphoric acid (omitted)	No manuring	49	59	53	59
8. Mineral Mixture	do	49	55	55	49
9. Organic Mixture	do	30	37	37	56
10. Control	Control (no Tephrosia planted)	27	34	30	28
11. Potash omitted	No manuring	53	38	37	55

RAINFALL.

	1914.	1915.	1916.	1917.
January ...	2·47	10·47	·67	5·80
February ...	·22	4·62	·03	7·04
March ...	12·21	3·24	6·59	12·83
April ...	9·98	8·03	10·51	2·42
May ...	8·59	2·55	8·38	8·44
June ...	13·18	9·16	13·62	11·14
July ...	1·94	12·40	12·19	4·49
August ...	5·31	·88	7·73	4·08
September ...	10·94	8·18	5·61	16·07
October ...	18·66	5·25	10·12	8·93
November ...	11·91	14·86	14·47	15·68
December ...	16·24	7·66	3·60	3·88
Total	111·65	87·30	93·52	100·80

Remarks.—

A study of the graph given on page 212 in connection with the Pitiakande Coconut Experiments is interesting. It clearly shows the effect of weather conditions on coconut yields. In 1915, good yields were obtained from all plots, in 1916 there was a general fall and in 1917 a general rise again. But beside these results it can be seen that there are two plots which have been giving increasing yields, despite weather effects, since the commencement of the experiments. These are plot No. 4 which has been cultivated monthly and plot No. 5 around the trees of which cattle has been tied. The value of cultivation of coconuts is being demonstrated by these experiments and the local value placed upon cattle manure is being substantiated.


1914
1915
1916
1917
100
90
80
70
60
50
40
30
PITIYAKANDE COCONUT
EXPERIMENTS.
4 Stirred monthly
2 Lime
5 Cattle tied amund Trees
3 Ploughed
1 Estate mixture
7 Nitrolim and Sulphate of Potash
9 Organic
11 Nitrolim and Basic Slag
8 Solubles
6 Control - kept in grass
10 Control
A.C.M.

TRIAL GROUND, NEGOMBO.

Average length of last mature leaf	Treatment *		Leaf Measurements. June 1914	Leaf Measurements. Decr. 1914	Leaf Measurements. June 1915	Leaf Measurements. Decr. 1915	Height of Trees June 1916	Height of Trees Decr. 1916	Height of Trees June 1917	Height of Trees Decr. 1917
Plot 1 -	Gd. nut ... ... N=30 St. B. D. ... ... P=30 S of P. ... ... K=30		60·29	78·85	107·62	132·52	153·83	183·54	204·86	217·46
Plot 2 -	Bone meal ... ... P=30 S of P. ... ... K=30		61·64	74·19	100·61	125·78	147·25	182·26	188·32	212·25
Plot 3 -	Gd. nut cake ... ... N=30 S of Potash ... ... K=30		60·99	74·84	102·58	128·90	144·76	177·55	181·86	214·64
Plot 4 -	Gd. nut cake ... .. N=30 Bone meal ... ... P=30		55·75	72·58	101·58	123·61	142·99	166·98	176·45	197·58
Plot 5 -	No manure, ploughed every month		50·93	65·83	97·29	121·52	143·90	168·70	188·88	227·54
Plot 6 -	Green manure ... ... P=30 Basic slag ... ... K=30 S of P.		47·36	62·90	86·97	107·17	120·65	149·51	153·54	207·50
Plot 7 -	Solubles ... ... N=30 P=30 K=30		42·64 44·07	54·46 57·71	80·94 91·44	117·29 108·12	136·65 125·56	160·80 145·76	186·48 171·49	215·00 213·15
Plot 8 -	No manure		46·97	58·88	80·53	94·91	105·99	119·71	136·82	151·23
Plot 9 -	No manure, clean weeded †		45·53	56·48	79·70	95·91	112·36	133·93	154·62	181·44
Plot 10 -	Mineral mixture with lime	N=30 P=30 K=30	45·85	56·69	51·83	97·71	116·78	134·35	150·06	174·99

* 1914 and 1915, 15 lb. each of Potash, Phos. Acid and Nitrogen were applied to the plots.
1916 and 1917, 20 lb. each of Potash, Phos. Acid and Nitrogen were applied to the plots.

† Has received an application of Potash since June 1916.

EXPERIMENTS WITH COCONUTS.

MUDALIYAR A. E. RAJAPAKSE.

To Test the Keeping Qualities of Nuts.

The following experiment commenced on December 16th, 1916, and was concluded on November 30th, 1917.

Two hundred and forty nuts were selected and separated into 24 lots of 10 nuts each. Each lot weighed about 40 lb. They were all weighed, each nut being weighed separately. Twelve lots (1-12) were numbered and stored in a room while the other twelve (13-24) lots were heaped up on the ground in the open.

When the experiment was begun lot 1 in the room and lot 13 heaped up outside were husked for conversion into copra. The nuts were weighed before husking—the weights of the husks, water, kernels and shells being recorded separately. The kernels (with the shells) were exposed for drying and were weighed daily until converted into copra and the shells were weighed on separation. The copra thus made was stored and was weighed once in 15 days for 3 or 4 months.

The lots 2 and 14 were similarly treated a month later, and similarly weights of other lots were recorded monthly until the end of the year.

An interesting series of figures was obtained, of which the following summary is worthy of close study :—

Nuts stored in Room.

Lot No.	Weights of green nuts ozs.	Weight of kernels ozs.	%	Weight of copra ozs.	%	Weight of water ozs.	%	No. of nuts per candy (560 lb.) of copra
1	627·25	173·00	27·58	96·50	15·38	57·50	9·17	910
2	629·00	152·00	24·17	89·50	14·23	51·50	8·19	984
3	563·00	133·75	23·76	85·00	14·92	28·00	4·97	938
4	579·00	127·00	21·93	76·75	13·26	24·00	4·14	1056
5	642·00	143·00	22·27	96·50	15·03	16·50	2·57	931
6	677·00	143·00	21·12	94·75	13·99	9·00	1·33	1001
7	665·00	124·50	18·72	89·00	13·38	3·00	·45	1046
8	608·00	115·50	19·00	92·50	15·21	nil	nil	920
9	676·50	124·00	18·33	99·00	14·63	nil	nil	957
10	625·00	120·00	19·20	94·00	15·04	nil	nil	931
11	530·50	98·00	18·47	81·00	15·27	nil	nil	917
12	534·00	86·00	16·10	69·00	12·92	nil	nil	1084

From these figures it is seen that the percentage weights of copra varied but slightly throughout the whole year while the weights of the water after two months showed a diminution of one half and a total disappearance of the water after seven months.

Nuts heaped in Open.

Lots No.	Weights of green nuts ozs.	Weight of kernels ozs.	%	Weight of copra ozs.	%	Weight of water ozs.	%	No. of nuts per candy (560 lb.) of copra
13	627·00	163·50	26·08	96·25	15·35	58·25	9·29	912
14	583·00	139·00	23·84	88·25	15·14	38·50	6·60	925
15	603·00	139·00	23·05	87·00	14·43	31·50	5·22	970
16	657·00	161·50	24·58	100·00	15·22	47·00	7·15	920
17	754·00	156·00	20·42	102·00	13·53	29·00	3·85	1035
18	675·50	145·50	21·54	95·00	14·06	16·00	2·37	996
19	686·00	148·00	21·57	83·25	12·12	11·50	1·67	1155
20	732·50	139·00	18·98	80·25	10·95	17·00	2·30	1279
21	679·00	106·00	15·61	80·50	11·85	10·00	1·47	1181
22	630·00	88·00	13·97	62·00	9·84	nil	nil	1423
23	647·00	94·00	14·53	68·00	10·51	4·00	·62	1332
24	746·00	144·00	19·30	65·00	8·71	6·00	·80	1607

The figures show that the water in the nuts heaped up in the open diminishes after the first month of storage but does not totally disappear. After the fourth month there is a deterioration in the copra out-turn and this deterioration becomes marked after the sixth month.

These experiments tend to show that small quantities of nuts can be stored without marked deterioration for at least twelve months, provided that they are under shelter. It remains to be ascertained whether large quantities can be similarly dealt with.

MAINTENANCE OF SOIL FERTILITY.

The experiment was begun on February 14th, 1917, to determine the fertility of a coconut land and whether its productivity could be maintained if its products are returned to it.

The fallings from the palms, including the leaves, husks of nuts, water of nuts, shells of nuts and 1/3 of the weight of the copra in the form of poonac are all returned to the soil once a year.

1st Year's Report.

Trees, 35.

Crop, 6 (once in two months).

Bunches cut, 406—average, 11·60 per tree.

Branches (leaves) fallen, 410—average, 11·71 per tree.

Nuts, 2,165—average 61·86 per tree.

Weight of the nuts on picking dates: 7,935 lb. and 1½ oz.—average weight of a nut, 3·66.

Weight of the nuts after two months: 5,903 lb. 8 oz.—average weight of a nut, 2·73 (dry).

Weight of husks: 2,728 lb.—average weight	...	1·26 (dry)
Weight of water, 577 lb. 7 oz. average	...	·27
Shell weight, 743 lb. and 3 oz. average	...	·34
Copra weight: 1,015 and 15½ lb.	...	·47

Weight of the fallings returned to the soil.

	lb.	oz.
Leaves (or branches)	2,644	½
Fallings	759	7½
Husks	2,728	0
Water	577	7
Poonac (1/3 of the weight of copra)... ...	338	10
Shells	743	3
	7,790	12

FOOD STUFFS.

CULTIVATION OF THE POTATO.

BY THE EDITOR,

Queensland Agricultural Journal.

Next to the cereals, the potato is probably the most important food plant grown for man. It is a native of America, and was brought to England between the years 1580 and 1585 by Sir Walter Raleigh, from Virginia. It was received, however, with great disfavour; and the Church condemned it as an unholy article of diet, seeing the race and place from which it originated. It was not until the year 1805 that, by the exertions of Dr. Buchan, it became popular. In France it was quite neglected until a certain gardener, who had grown some and found no sale for them, induced one of the kings of France to wear a potato blossom as a button-hole. This at once popularised the despised potato in that kingdom. Chemically, the potato consists of starch, gluten, and woody fibre, with, of course, water. On the authority of the late John Wilson, Professor of Agriculture, Edinburgh, an 8-ton crop of potatos, taken from 1 acre of land, removes from the soil in which the tubers were grown—of the bases of alkaline earths, 90 lb. of potash, 8 lb. of soda, 5 lb. of lime, 7 lb. of magnesia; and of acid, 34 lb. of sulphuric acid, 20 lb. of phosphoric acid, 10 lb. of hydrochloric acid—in all 170 lb. of inorganic matter. This was for tubers alone; and, if an equal quantity were allowed for the tops, the quantity taken from the soil would be almost doubled.

MANURES.

It is, therefore, evident that, to grow potatos to perfection, the foregoing constituent elements must be present in the soil. Professor Wilson found the best results to be obtained by preparing the soil early, and applying phosphatic and potash manures some time before planting, in the proportion of about 150 lb. to the acre. At the time of planting, nitrate of soda is sown in the drills at the rate of 1 cwt. per acre, and from $\frac{1}{2}$ to $\frac{3}{4}$ cwt. at earthing-up time.

On light, poor, sandy soils, nitrogenous manures in the form of sulphate of ammonia should be supplied at the rate of from 140 lb. to 170 lb. to the acre—one-half to be used at the time of planting, and the other half at the final earthing-up.

The matter of farmyard manures in growing potatos is a somewhat vexed question. Undoubtedly farmyard manure is good, provided that it has been properly fermented and well decomposed; but there is nothing more fatal to good results with potatos than putting fresh manure and potato setts together, for the young plant can never force its way through the fermenting mass of decay consequent upon slow decomposition.

Some interesting experiments, made in England by Mr. E. B. Hodley, Agricultural Superintendent to the Wilts County Council, threw considerable light on the matter of the use of artificial manures. The seasons were dry ones and therefore more favourable to farmyard manures than to artificials,

the yield from its use being considerably in excess of that obtained from the heaviest dressing ($12\frac{3}{4}$ cwt.) of mixed artificial manures. Where nitrogen, phosphoric acid, and potash have been applied in artificials, excellent crops have been obtained; but the heaviest crop of all was 14 tons per acre as the average of four years, grown where 8 tons of farmyard manure and 4 cwt. of sulphate of ammonia per acre were applied. The complete chemical manure was applied on different plots at the rate of 4 cwt., 8 cwt. and 12 cwt., respectively. Taking the averages for the four years, the 8 cwt. dressing proved the most economical, although the 12-cwt. dressing gave a somewhat heavier yield. When any one of the three constituents of the complete manure was omitted, there was a decrease of yield. Where the nitrate was omitted, the increase resulting from the application of kainit and superphosphate was not sufficient to pay for the cost; where superphosphate was omitted, the application of nitrate and kainit gave very little profit in excess of that obtained from the unmanured plots; and although where kainit was omitted the yield most nearly approached that obtained from the completely manured plots, yet, even in this case, the profit was less than that obtained with a cheaper dressing of complete manure.

In conducting experiments of this nature, it should be remembered that artificial or farmyard manures will not invariably produce the same results on different soils. The rich, black soils of the Darling Downs, for instance, contain certain constituents which are wanting in lighter western or coast soils. In some there may be already a sufficiency of phosphoric acid; consequently, an application of superphosphate might prove injurious. Where cultivation grounds are deficient, as most of them are, in phosphoric acid, it becomes necessary, in order to obtain a better crop, to secure support in the form of an easily soluble phosphoric acid. Bonedust is a phosphoric acid manure which gives this result; but superphosphates produce better and quicker results.

For potatos, a fertiliser rich in potash is essential. For general purposes a good mixed fertiliser for this crop should consist of—Available phosphoric acid, 7 per cent.; potash, 11 per cent.; nitrogen, 3 per cent.; 700 lb. to the acre.

Sulphate of potash is mostly employed as a source of potash for potatos. Muriate of potash is said to give even better results than the former.

Dried blood contains, on an average, 11 to 13 per cent. of nitrogen, but it is less soluble than sulphate of ammonia and nitrate of soda. Manures containing sulphate of ammonia should not be mixed with lime, nor applied to land which has been recently limed.

The value of kainit lies in its potash, of which it contains 12 per cent. It is the cheapest of the potash manures.

Following are the results of some experiments carried out by Mr. H. C. Quodling, Director of Agriculture, when Manager of Westbrook State Farm. The manures used were—

Superphosphate, at the rate of 4 cwt. per acre.

Bonedust, at the rate of 4 cwt. per acre.

Blood, at the rate of 4 cwt. per acre.

Kainit, at the rate of 4 cwt. per acre.

One plot was unmanured, and planted with cut potatos, and in the last plot, also unmanured, the potatos were planted whole.

Manure.	Rate per Acre.	Weight of Seed Planted.	Cut or Uncut.	Yield per Plot.	Area of each Plot.
	cwt.	lb.		lb.	Acre.
Superphosphate - -	4	178	Cut.	716	¼
Bonedust - -	4	178	,,	704	¼
Blood - - -	4	178	,,	712	¼
Kainit - - -	4	178	,,	722	¼
Unmanured - -	...	178	,,	751	¼
Unmanured - -	...	178	Uncut.	708	¼

The best manure then, for potatos, is a mixture of farmyard manure and some artificial. For instance, 16 tons of stable manure per acre will produce a larger crop than the most remunerative dressing of artificial manure ; but, employ a mixture of 8 tons of stable manure and 3 cwt. of nitrate of soda, or an equivalent quantity of sulphate of ammonia, and a far greater yield will be obtained—in fact, such a dressing gives the greatest yield and the most remunerative results of any. If stable manure is unavailable, any artificial dressing for potatos should contain nitrogen, phosphorus, and potash. Omit one of these (as has already been shown), and the result will be a poor crop. The omission of nitrogen will cause the greatest loss, and that of potash the least.

SOILS.

Of all crops grown, the potato is the one which shows the greatest content of potash in the mineral constituents withdrawn from the soil. Hence the well-known value of soil derived from granitic detritus for potato culture. In it, we have abundance of potassium silicated derived from the decomposing felspar and slowly set free in other forms, for the uses of the plant. Where ground has been annually cropped with potatos for many years without a rotation, it is mainly owing to the potash having been used up that the soil is not liberal in its return of tubers.

Some of our scrub soils yield a fairly good crop of tubers, but rarely over 4 tons to the acre, and these are usually somewhat watery and bad keepers, while there is frequently an abnormal growth of tops. The best potato lands in this State are the black and red soils of the Darling Downs, notably at Allora, and, nearer the coast, at Forest Hill, Laidley, and Gatton, where an 8-ton crop is no rarity. Generally, it may be said that potatos may be grown on any soil, but that those grown on clay soils are waxy and of bad quality ; light, granitic soils produce nice, mealy potatos ; and fertile loams yield the best tubers—best both in quality and quantity.

SEED POTATOS.

When we speak of seed potatos, we mean potato tubers which are planted, whole or cut, to produce a crop. Potato seed is a very different thing. The potato is a Solanum, which produces flowers and seed vessels. The latter appear in the form of a small green apple or tomato, which contains a quantity of small seeds, and it is by sowing many thousands of these

seeds that new varieties are produced, in very limited numbers compared with the enormous numbers of seeds sown, by scientific-growers, who make the production of new kinds of potatos a business, and a very profitable business it has often proved to these experimenters. Here, however, I am dealing only with the tubers or so-called seed potatos.

There is a good deal to be studied in the selection, care, and treatment of seed potatos, and many farmers take far too little care of them. When the summer crop is dug, the small potatos are hauled to the barn, and either left in bags till the next planting season comes round, or else in a large uncovered heap on the floor. Then, when planting time has arrived, it is considered time enough to overhaul the heap, bags, or pit, and pick out the rotten ones. Too often the seed is found in a matted condition, owing to the potatos not having been turned. This necessitates the whole mass being stirred up—a process which breaks off the majority of the shoots. All this means loss—a loss which can easily be avoided by being careful to turn the seed over occasionally, say about once a fortnight, or, at any event, a fortnight before planting, by which a gain in growth may be brought about. New shoots will then form, and they will be up as early as those which were planted immediately after the last turning. An important point is to plant no potatos except those which have sprouted. This was conclusively proved to be correct at the Queensland Agricultural College, when one plot was planted with sprouted, and another with unsprouted seed. The former came up uniformly with scarcely any misses, whilst the latter plot showed an irregular growth and wide vacant spaces. In trials which were carried out for the Irish Department, at sixty-seven centres in sixteen countries, there was an average increase of 2 tons per acre from sprouting, and in the four preceding seasons the increase due to sprouting ranged from 1 ton to 2 tons 13 cwt. No stronger testimony could be desired.

Now, concerning the size of seed tubers. Opinions differ as to whether small or large seed gives the best results. A trial was made in England to settle the question. Three rows of equal length and with an equal number of setts were planted with Northern Star potatos as follows :—

Row No. 1 : 38 setts, weighing 3 lb., produced 54 lb. of potatos.
Row No. 2 : 38 setts, weighing 4 lb., produced 64 lb. of potatos.
Row No. 3 : 38 setts, weighing 7 lb., produced 92 lb. of potatos.

Assuming that the seed cost 1*d.* per lb. and the produce sold at 1*d.*, we find that row 1, returned 4*s.* 3*d.*; row 2, 5*s.*; and row 3, 7*s.* 1*d.*—clearly a great gain in favour of the larger setts. All were planted on the same day, in equal ground, and all had the same amount of cultivation.

This leads to the subject of planting whole or cut tubers. Here again opinions differ. Some think it a waste to plant the setts whole, while others think the best results are got with uncut seed. Now, at the Guelph Farm, Michigan, U.S.A., experiments were made which lasted for four years, to decide the matter. These experiments are reliable, and emphatically show the advantage of planting good setts.

The experiments were made to test the effect of the number of eyes in the setts. The difference in the yield between those with one eye and those

with five was found to be very considerable, amounting to about 28 bushels, the results being as follows :—

From 1 eye, 136·41 bushels per acre.
From 2 eyes, 144·70 bushels per acre.
From 3 eyes, 153·13 bushels per acre.
From 4 eyes, 162·82 bushels per acre.
From 5 eyes, 164·37 bushels per acre.

Up to four eyes in each sett, the increase in the field is, roughly, 9 bushels for each additional eye, so that, up to that extent, the increase in eyes would be well repaid in the field.

Against this experience, I place that of a Queensland potato-grower, Mr. James Pink, of Wellington Point. He says :—It has been the practice to select for propagation the refuse of the potato heap; small, ugly, ill-shaped tubers have been considered good enough for seed, and where the result has not come up to expectations, the cry is raised that the potato is degenerating. In carrying out this practice for years, was it possible to arrive at any other result? But the very art of gardening is to lift Nature above her normal state, by raising new and improved varieties of seed, and by selection.

The method of selection is peculiarly adapted to the principle of growing from single eyes. If we take an average good-shaped potato, weighing from 6 to 10 oz., we shall find that it has from 12 to 18 eyes, which, if cut into single eyes, would give as many setts, which would naturally produce a more even sample than the same number of whole tubers of different sizes. The principle of growing from single eyes has two great advantages—namely, economy of seed, and, upon suitable, well-tilled land, a larger crop of marketable potatos.

When whole tubers are planted, two or three eyes start into growth first : these keep the lead during the entire growing season, and from their stolons the largest potatos are produced. The weaker eyes start later into growth, and produce only small tubers of little value ; but, when single eyes are planted, the whole strength of the sett is devoted to one growth ; all the young tubers are formed nearly at the same time, and the plant, having no other calls on it for nutriment. these continue to grow and form large tubers. The whole tuber produces the largest number of potatos, but the single eye will produce the most uniform sample and the heaviest crop per acre.

With a view to ascertain the relative productiveness of tubers and setts, a series of experiments was carried out in the gardens of the London Horticultural Society. A piece of ground was divided into 4-ft. squares, and in the centre of each square was planted either a whole tuber, or a single eye, or a sett containing three eyes on the whole surface of the tuber pared off so as to leave the eyes safe, but removing the centre—a practice not uncommon in Scotland. These were, in fact, potato peelings. If we consider the results of the whole sixteen experiments as being but one experiment, we shall find their proportions expressed by the following figures :—

Whole tuber	333·38, or 2	nearly
Single eyes	717·87, or 11	
Three eyes	613·94, or 5	
Parings	504·69, or 4	

In adopting the principle of the single-eye culture, it is requisite that the eye should be taken from large or averaged sized potatos, for the smaller the potato the weaker its producing powers. The crown eye always grows the strongest, and produces the largest potatos. The eyes taken from the middle of the potato produce the best-shaped and most uniform tubers.

There are several ways of cutting the potato into single eyes. The principal thing to aim at is, to obtain a fair share of flesh of the tubers to each eye, with the least amount of cut surface. Take any potato and hold it before you with the stem end down. You will notice that the eyes are arranged around the tuber in regular ascending rotation from the bottom to the top, similar to the thread of a corkscrew. Now, take a sharp thin-bladed knife and remove the first eye by placing the knife equally distant between it and the eye next in rotation above it, sloping it to the indenture left by the stem, removing the flesh with it.

When the first eye is removed, turn the potato in your hand till the next eye appears ; remove this in the same manner, and keep on turning the potato, removing each eye as it appears. These sets should be planted as soon as cut, and a little hot lime thrown over them will absorb the moisture, prevent premature decay, and also the attacks of insects. The above method could, however, scarcely be adopted by a farmer who plants large areas of potatos. As an experiment, it is, of course, very interesting and instructive, and useful as being a simple means of increasing valuable new varieties of potatos.

Some farmers utterly condemn the time-honoured practice of cutting up the potato into setts. One man says :—In all the trials which have been recorded of the potato crops produced from cut and uncut seed, I have never met with an instance of the cut tubers yielding the most or best. This fact must surely be generally known, and it is most surprising that it is not acted on. The process of cutting may increase the setts by about 30 per cent., but, if the time taken in cutting them, and the decreased yield be taken into consideration, no advantage whatever is secured, but the reverse. A man is far better off with a piece of land planted with 25 or even 30 cwt. of whole tubers than if it were planted with 1 ton cut up to cover the same space. If cutting the potato is done to save seeds, that is a very poor reason.

In dealing with the cutting of potatos, the large tubers are mostly cut into three pieces, the medium ones into two, and the small ones are let go whole. Plant the best and largest cut sett side by side with a whole tuber ; it will invariably be found that the whole tuber produces the greatest number of potatos, and certainly the largest ones. The difference in favour of the whole sett I have frequently found to be 2 lb. to one plant, and imagine what this means in the case of thousands or tens of thousands of plants. The scarcer and more expensive a variety is, the more it is cut; and, consequently, the worse for the crop, and productive of certain degeneration. It appears to the writer, from his own practical experience, that, if potatos are cut into setts with at least three eyes, the result is equally as good as when the whole tubers are planted, and that in the latter case there will be a larger proportion of small potatos.

SPROUTING SEED POTATOS BEFORE PLANTING.

This is more often practised by cultivators of gardens than on the farm, but it has some decided advantages which all potato-growers may benefit by.

Seed potatos are often badly prepared for planting, and still more often are not prepared at all. As a rule, they are kept in heaps in the barn or in bags till they are wanted in February or in August, or in a damp shed, where it is usually found that the growths have made considerable progress. The sprouts may be 2, 3, or 4 in. in length. They grow over and amongst the tubers like a network, and the greater part of them are broken off in moving the tubers, or before they can be separated. Many have little regret in doing this. They think it is necessary, and it is ; but it is also exceedingly harmful, and this ought to be remembered, as deteriorated seed is always more or less unproductive. Fancy what the result would be were we to allow our corn to sprout unduly before sowing! The excuse is that potatos will resprout, and they will ; but never so robustly as in the first instance. These long growths take a great deal out of the tuber which ought to be kept in reserve to facilitate the ordinary growth in the soil, and superfluous growth should be wholly prevented. This is easily accomplished if given timely attention, and I would urge growers that they look to their seed tubers at once.

The first treatment should consist of preventing the growths from becoming long or of a pale colour, which occurs when they are kept in the dark. Begin keeping them in the right way by turning the tubers over and removing any diseased one meets with. Do not put them in a heap again, but lay them out in a single layer on the barn floor or some other building where they will be fully exposed to the light and receive a good deal of air. This will not only check the production of long, weakly shoots, but it will green and harden the tubers, and this is a great benefit to them, as a greened tuber is much more hardy to come in contact with the soil than one that has been kept from light and air for six months or more. The growths, which will be slowly produced when laid out in a single layer and in light and air, will be short and robust and altogether different and superior to the shoots drawn up in the heap.

THE LEAST EXPENSIVE WAY.

This laying out is one way of sprouting potatos which should be followed by every farmer who attempts potato culture. It is the least expensive way of treating them, and will always pay handsomely, as the first growth and subsequent results from prepared tubers are infinitely better than when they are taken straight from the heap and planted, which very many are, unfortunately. But there is another way of sprouting which is still better. This is to get a number of wood trays from 2 in. to 3 in. deep, and of any width and length ; from 3 ft. to 4 ft. long, and 2 ft. to 3 ft. wide, are handy sizes. A little fine soil is put in the bottom, and the tubers are stood up on end as close as they can be packed in the trays. The ends with the eyes or buds on them are kept up, and the trays are placed in light, airy sheds, or such like places. Forcing them into growth is not advisable, the object being to get hardy little shoots on the tubers, which will not be checked when they come in contact with the soil in planting. The growths should not be more than 1 in. long when planted, and $\frac{1}{2}$-in. is quite as useful a length. If trays cannot be provided for all of them, there is no reason why the whole should not be laid out in sheds, or the early sorts may be sprouted in trays first,

planted, and the trays again filled with late kinds. The right time to put them in trays is before growth begins, and many of the early ones will require attention at once. Sometimes there are blind tubers. When these are planted there is a blank, but in sprouting none but growing tubers should be planted. If it is seen that the growths are likely to exceed 1 in. in length before they can be planted, check them by admitting more air, but in doing this take care that a cold cutting wind does not reach them, and always be sure that they are protected from frost if that is occurring, as it still may. When the tubers are planted quite dormant it is often a long time before growth shows above ground. It might often be earlier without much chance of being injured by frost. All, too, desire their crops as early as possible if grown to meet early markets, and there is no better way of helping them on than the process of sprouting before planting, and having both tuber and growths in a sturdy, hardy condition when put in the soil. I have found this brings the crops in a fortnight or three weeks sooner at digging time than dealing with unsprouted tubers or those sprouted in the heaps, and the yield is also better from sprouted setts than unsprouted sets. Do not run away with the idea that there is a good deal of fiddling labour about it, and if not worth the bother, but look on it as a very important aid to successful culture and extra remunerative returns, and you will not be disappointed.

There can be no doubt that seed potatos are weakened by rubbing off the shoots when they have sprouted badly, but that a good crop may be obtained from a second sprouting has often been proved. Potatos have even been planted when every vestige of a sprout was rubbed off and not an unsprouted eye appeared, yet they sent up vigorous shoots.

FLOWERING AND SEEDING.

Under favourable conditions the potato plant flowers freely, and produces a green berry which contains the true seed of the plant. It is from these seeds that the different new kinds of potatos are produced. I need not here go into the matter of the production of seedling potatos, as what is intended here is merely instruction to young farmers who have had little or no experience previously in the art of successful potato-growing. The work of raising new varieties is expensive and tedious, and is only undertaken by certain growers (as I shall presently show when I come to the cross-fertilising of potatos), who practically devote their lives to the business, sowing hundreds of thousands of seeds, to find sometimes only one new plant worth cultivating.

The potato plant does not produce seed so freely in this State as in colder climates, and it is, perhaps, as well that it does not flower heavily, since experiments on

THE EFFECT OF FLOWERING OF POTATOS

made by a German scientist, some years ago, to ascertain whether blossoming was detrimental to the development of potato tubers, showed that the effort of the plant to provide for its reproduction by means of seeds seemed to result in a corresponding weakness in its root growth and in the size and numbers of the tubers. The experiments were carried out on a number of plots on similar soil, every condition being exactly the same. On one plot the plants were allowed to bloom as much as they liked, but the blooms of

the plants in the other plots were cut off at different times. The crop that had not been topped at all was the worst yield, and the best crop was the one that had been prevented from blooming by being topped at frequent intervals. Those that were topped at the latest stage of the plant's growth were not so satisfactory as in the case of the crop frequently topped off.

(To be Continued.)

NOTES ON TREATMENT GIVEN TO *CAJANUS INDICUS* (DHALL).

The Director of Agriculture, Mysore, has kindly furnished the following memorandum on the preparation of dhall for the market :—

Large quantities of *Cajanus Indicus* are soaked in water for a night and the next morning the soaked seed is mixed with puddled red earth and heaped up with a long wooden pole inserted in the centre of the heap. The heap is left undisturbed for 24 hours by which time the water in the heap drains away. The next morning the wooden pole is shaken in all directions so as to loosen the seeds from each other, and any seeds attached together are detached by gentle pressure of the hand. The seeds thus treated are now ready to be dried. They have to be dried from 3 to 6 days depending upon the severity of the sun. Soaking is usually done during bright sun-shine. When the seeds are thoroughly dried they are passed through sieves so as to separate them from the red earth which passes through. The seed thus treated is now ready for the grindstone which removes the husk and splits the seed. Small pieces of husk may still be found attached to the split seed, but in the dhall coming into the market this is overlooked and the consumer is expected to thoroughly clean the dhall by gentle pounding and winnowing.

Points to be noticed :—

1. Brackish water should not be used for soaking *Cajanus Indicus*.
2. Red earth is preferred but if it is not available any other earth may be used : but the earth should not be of a saline character.
3. If the soaking is followed by rainy or cloudy days the dhall will become mouldy and will not cook well.
4. If the grain is treated by the consumer himself he should split the seed in small quantities as required, as freshly split dhall has a better flavour than dhall split long before consumption.

RESULTS OF EXPERIMENTS WITH FOOD STUFFS.

The following are the reports on experiments conducted by the Senior Agricultural Instructor of the Society with paddy, shallot, and dhall :—

PADDY SEED SELECTION AT PERADENIYA.

Extent: 2½ acres.

Sown: November 14th, 1917.

Harvested: February 13th, 1918,

Manure Used: Nil.

Pests and Diseases: The paddy borer caused a little damage.

General Reports on the Growth: Satisfactory. Only about 8 bushels of seed were selected.

Yield of the Plot: 64 bushels paddy.

SHALLOT EXPERIMENT AT UDUWAWELA, HARISPATTU.

Nature and Object of Experiment. To demonstrate the possibility of growing onion locally.

Extent: 4 beds, 8 ft. × 3 ft.

Sown: 8th December, 1917.

Harvested: 28th February, 1918.

Nature of Soil: Sandy loam.

Manure Used: Nil.

Cost of Experiment: 8 lb. seed bulbs (48 cents).

Pests and Diseases: Nil.

General Reports on the Growth: Good.

Yield of the Plot: 72 lb. bulbs fresh, 24 lb. dry.

,, *per Acre:* 36,000 lb. bulbs fresh, 12,000 lb. dry.

DHALL EXPERIMENT AT DUNUWILE.

Nature and Object of Experiment: To find out if dhall will suit the country.

Extent: Along drains and paths and in small lots in all about 300 plants.

Sown: 24th June.

Harvested: January—March.

Nature of Soil: Sandy loam.

Manure Used: Nil.

Cost of Experiment: No record kept.

Pests and Diseases: Nil.

General Reports on the Growth: Very steady growth and heavy crop.

Yield of the Plot: 16 lb. of cured seed.

,, *per Acre:* 600 lb.

Results Previous to Experiment: Nil. Further trials are being made.

PADDY EXPERIMENT AT YATIWAWELA.

Nature and Object of Experiment: Reduction of seed paddy. 3/5 of the usual quantity was only used. i.e. instead of 10 lahas only 6 were used and transplanted 2 seedlings 6 inches apart.

Extent: ½ acre (10 lahas=1 bush.)

Sown: 2nd September, 1917

Transplanted: 22nd October, 1917.

Harvested: 4th March, 1918.

Nature of Field: Well watered, fertile.

Manure Used: Nil.

Cost of Experiment: No record kept.

Pests and Diseases: Nil.

General Reports on the Growth: Plants grew up very steadily and bushed out excellently. The height of the plants were well over 5 feet and carried full of ear heads.

Yield of the Plot: 40 bushels.

„ *per Acre:* 80 bushels.

N.B.—This saving of seed can be effected all over.

TRANSPLANTING PADDY.

The following report is on an experiment conducted by Agricultural Instructor Karunanayake of Matara on Paddy (transplanting) in the village of Meddewatte in the Matara District :—

Nature and Object of Experiment: This field adjoins the river and is subject to damage by brackish water running into it at high tide sometimes when the seedlings are young. The object of the experiment was to see if bigger plants when transplanted would resist.

Extent: One acre.

Sown: 25th July, 1917.

Transplanted: 15th September.

Harvested: 8th February.

Nature of Soil: Rather saline.

Manure Used: Nil.

Cost of Experiment: No record kept

General Reports on the Growth: About 30% of the seedlings died but these were replaced at once from the nurseries. Growth much better than previous year.

Yield of the Plot: 20 bushels (4 kurunies sown).

„ *per Acre:* „ „

Results Previous to Experiment: 8 bushels (2½ bushels sown).

RUBBER.

RUBBER TAPPING EXPERIMENTS, PERADENIYA.

The results of the rubber tapping experiments being carried out at the Peradeniya Experiment Station were presented to the Committee of Agricultural Experiments at its meeting held on the 7th March. The following is a brief summary of the results of these experiments :—

TIME INTERVALS.

4 cuts on one-third circumference.

	80 C. Three times per week. grams.	78 A. Twice per week. grams.	78 B. Once per week. grams.
1912-14 (2½ years) ...	3657	3518	1972
1915	2058	1830	915
1916	2199	2135	880
1917	2697	2267	1088
	lb.	lb.	lb.
1917	5·9	5	2·4
from 1912	23·4	21·5	10·6

These experiments give information regarding the yields from series of trees that were tapped at different intervals of time. These experiments are carried out with 4 cuts on 1/3 circumference, having been started in 1912, and it is proposed, if possible, to arrange for further time interval experiments with one and with two cuts.

TAPPING SYSTEMS.

Tapping on one-third circumference.

80 C. 4 cuts, 1 foot apart, three times per week.
81 A. 2 cuts, 1 foot apart, three times per week.
81 B. 2 cuts, 2 feet apart, three times per week.
81 C, 1 cut at 3 feet, six times per week.

	80 C. grams.	81 A. grams.	81 B. grams.	81 C. grams.
1912-1914	3657	3373	3617	3197
1915	2058	1815	1587	1535
1916	2199	1863	1651	1810
1917	2697	1624	1531	1555
	lb.	lb.	lb.	lb.
1917	5·9	3·6	3·4	3·4

These figures show but little difference between the 81A, 81B and 81C groups, and that tapping four cuts does not give double the yield of two cuts. Group 81A has given slightly better results than group 81B.

Change-over Tapping.

78C. Single cutting at 15 inches on one quarter, alternate days.

	Continuous. grams.	Changed-over every three months. grams.	
1914 ...	1023	901	Double tapping at change.
1915 ...	1029	1378	
1916 ...	978	1394	
1917 ...	1306	1465	No double tapping.
Total ...	4336	5138	

This group appears to demonstrate an advantage in the change-over tapping system even when there is no double tapping at change.

88C. V cut on half circumference, at 3 ft., alternate day.

	Continuous. grams.	Changed-over every three months. grams.	
1915 ...	1468	1348	Double tapping at change.
1916 ...	1489	1545	
1917 ...	1616	1276	No double tapping.
Total ...	4573	4169	

This group, however, shows no advantage from the change-over system, there having been a fall in 1917 when no double tapping at change was carried on.

V cut versus single cut.

80C. etc. cut on one-third at 3 ft., alternate days.

	V cut. grams.	Simple oblique cut to left. grams.
1914	1170	1265
1915	1422	1454
1916	1564	1517
1917 (6 mo.) ...	678	659
Total ...	4834	4895

These trees have been rested for 6 months and the tapping on the next third has been reversed.

Tapping on Renewed Bark.

82B. Single cut on one-third at 15 inches, alternate days.

Age of renewed bark (Mar. 1918)	5 yrs. 9 mo. grams.	4 yrs. 8 mo. grams.	3 yrs. 7 mo. grams.
1916 (6 mo.) ...	1017	750	791
1917	1796	1465	1278

These results give some indication of yields from renewed bark of different ages. Measurements of the thickness of the bark show a slower rate of increase between 4 years 8 months and 5 years 9 months than between 2 years 7months and 4 years 8 months.

RUBBER MANURING EXPERIMENTS, PERADENIYA.

All trees were tapped with one cut on one-third left to right on alternate days. Manures were applied first in 1913 and from 1915 annually.

Per cent. of caoutchouc.	Gen Manure.	Ex. Nitrogen.	Ex. Phos. Acid.	Ex. Potash.	Min. Mix.	Control no manures.
1914	34·7 %	33·4 %	32·7 %	33·0 %	33·0 %	32·8 %
1915	33·8 ,,	33·9 ,,	33·8 ,,	31·4 ,,	32·3 ,,	32·5 ,,
1916	32·9 ,,	32·1 ,,	33·2 ,,	30·8 ,,	31·5 ,,	31·2 ,,
1917	35·6 ,,	35·9 ,,	37·3 ,,	34·7 ,,	35·3 ,,	33·9 ,,
Average for 4 years	34·2 ,,	33·8 ,,	34·2 ,,	32·5 ,,	33·0 ,,	32·6 ,,
Yield per tree.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.
1914	2 4	2 6	2 7	2 3	2 5	2 11
1915	3 0	3 8	3 9	2 11	3 3	3 10
1916	3 15	3 14	4 4	3 8	3 11	3 15
1917	4 6	4 7	4 10	3 11	3 9	4 1
Total for 4 years.	13 9	14 3	14 14	12 1	12 12	14 5
Average per annum.	3 6	3 9	3 11	3 0	3 3	3 9

The composition of the manures applied have been as follows :—

General Manure.

Groundnut cake	200 lb.	containing	
Bloodmeal	200 lb.	Nitrogen	50 lb.
Steamed bone meal	136 lb.	Phos. acid	30 lb.
Sulphate of Potash	75 lb.	Potash	30 lb.
Sulphate of ammonia	60 lb.		
	671 lb. per acre.		

or 6·71 lb. per tree

Excess of Nitrogen.

Groundnut cake	182 lb.	containing	
Steamed bone meal	53 lb.	Nitrogen	80 lb.
Bloodmeal	300 lb.	Phos. Acid	9·5 lb.
Sulphate of ammonia	150 lb.		
	675 lb. per acre.		

or 6·75 lb. per tree.

Excess of Phosphoric acid.

Groundnut cake	50 lb.	containing	
Steamed bone dust	200 lb.	Nitrogen	9·5 lb.
Basic slag	200 lb.	Phos. acid	80 lb.
	450 lb. per acre.		

or 4·5 lb. per tree containing 0·8 lb. Potash.

Excess of Potash.

Groundnut cake	136 lb.	containing Nitrogen 9·5 lb.
Sulphate of Potash	200 lb.	K_2O 80 lb.
	336 lb. per acre.	

or 3·36 lb. per tree containing 0·8 lb. Phos. acid.

Mineral Mixture.

Nitrolim	...	278 lb.	containing 50 lb. N.
Basic slag	...	176 lb.	30 P_2O_5
Sulph. Potash	...	75	30 K_2O
		529 lb. per acre.	
		or 5·29 lb. per tree.	

The results over 4 years indicate a slightly higher yield from the plot to which an excess of phosphoric acid has been applied. The lowest yields are given by the excess potash and mineral mixture plots but as these plots have not been thinned in a manner similar to the other plots, it has been decided to have the necessary thinning carried out.

CHANGE-OVER TAPPING.

The figures given below give the percentage of caoutchouc and the yield per tree in experiments testing the relative value of the simple alternate day system of tapping as against the change-over system :—

1914.		Alternate day.	Change-Over.	Rainfall.	Wet days.
1st quarter	...	39·7%	38·8%	7·09	21
2nd quarter	...	28·9%	35·8%	23·17	48
3rd quarter	...	30·8%	33·0%	18·48	44
4th quarter	...	31·4%	30·1%	33·98	65
Average	...	32·7%	34·4%	82·72	178
Yield per tree	...	2·4 oz.	1·15 oz.		
1915.					
1st quarter	...	36·2%	35·9%	15·42	23
2nd quarter	...	32·9%	34·4%	17·43	30
3rd quarter	...	26·6%	29·8%	28·81	49
4th quarter	...	33·4%	33·6%	26·73	51
Average	...	32·3%	33·4%	87·59	153
Yield per tree	...	2·3 oz.	3·0 oz.		
1916.					
1st quarter	...	36·6%	37·5%	11·13	15
2nd quarter	...	31·1%	33·3%	29·07	39
3rd quarter	...	25·4%	26·0%	23·89	58
4th quarter	...	32·6%	34·5%	19·97	43
Average	...	31·4%	32·8%	84·06	155
Yield per tree	...	2·2 oz.	3·1 oz.		
1917.					
1st quarter	...	32·2%	35·7%	18·44	42
2nd quarter	...	36·4%	38·3%	17·02	21
3rd quarter	...	39·5%	38·1%	31·39	47
4th quarter	...	36·2%	32·8%	32·61	44
Average	...	34·6%	35·9%	99·46	154
Yield per tree	...	2·12 oz.	3·3½ oz.		

The results indicate an advantage for the change-over system—the system used in these experiments.

The percentage of caoutchouc in the latex also shows a very slight advantage for the change-over system of tapping.

HENARATGODA TAPPING EXPERIMENTS.

Two groups of twenty trees each were tapped on opposite quarters, on the one side with a single cut and on the other side with two super-imposed cuts.

In the first group, the single cut A is at 15 inches from the ground, B, on the opposite side is at the same height and C is 2 feet above B.

In the second group A is at 15 inches, B, at the same height, and C, 1 foot above B.

The object of the experiment was to determine the relative yields of one cut and two cuts, and whether the upper cut had any influence on the lower.

Tapping began on September 1st. 1916 and has been continued to date. The trees are tapped three times per week. The yields from the three cuts are weighed separately.

In Group 1 (cuts 2 feet apart) the average girth of the trees is 47 inches. The yields for the 16 months ending December 1917 were :—

	A.	B.	C.
	32,429 grams	35,671 grams	18,283 grams
or per tree			
	1,621 grams	1,783 grams	914 grams
or	3·6 lb.	3·9 lb.	2 lb.

Taking the yield of the single cut A as 100, the ratios of the yields are 100 ; 110 ; 56 ; while the ratio of B to C is 100 ; 51.

The ratios of the yields for each month are :—

Sept. ...	100	124	78	May ...	100	108	64
Oct. ...	100	127	65	June ...	100	95	62
Nov. ...	100	127	63	July ...	100	106	52
Dec. ...	100	115	64	Aug ...	100	102	52
Jan. ...	100	109	70	Sept. ...	100	105	48
Feb. ...	100	96	72	Oct. ...	100	103	44
Mar. ...	100	103	67	Nov, ...	100	107	41
Apr. ...	100	110	56	Dec. ...	100	118	47

In group 2, (cuts one foot apart) the average girth of the trees is 55 inches. The yields for the sixteen months are

	A.	B.	C.
	51,020 grams	50,185 grams	22,953 grams
or per tree			
	2,551 grams	2,509 grams	1,197 grams
or	5·6 lb.	5·5 lb.	2·6 lb.

Taking the yield of the single cut A as 100, the ratios of the yields are 100 : 98 : 45 ; while the ratio of B to C is 100 : 45·7.

The ratios of the yields for each month are :—

Sept. ...	100	104	49	May ...	100	103	47
Oct. ...	100	108	46	June ...	100	93	45
Nov. ...	100	103	44	July ...	100	95	44
Dec. ...	100	92	45	August ...	100	95	44
Janry. ...	100	95	49	Sept. ...	100	96	52
Feb. ...	100	103	48	Oct. ...	100	97	44
March ...	100	96	44	Nov. ...	100	95	41
April ...	100	101	42	Dec. ...	100	99	40

The cuts have been tapped in the order, A, C. B. From December 1917, the order has been C. B. A.

TEA.

TEA EXPERIMENTS AT GANGAROOWA.

All the tea runs two years between the prunings, the Hybrid and single plots being pruned in the S. W. Monsoon and the Manipuri Indigenous Plots in January.

As several of the plots have been untreated for some years it was decided to begin Annual Artificial manuring experiments. This began in July 1917 and the following plots were divided into two and manured with mixtures containing one or more of the chief manurial ingredients, 20 lb. of each constituent being applied in each case.

Plots 141 to 143; 146 to 148 and 155 have been divided into half acre plots by planting at a short distance from each other jungle posts painted with white on top. These plots have been manured with the following:—

141 A. 146 A.	286 lb. groundnut cake 50 lb. sulphate of potash	each	20 lb. N. 20 lb. P_2 0.
141 B. 146 B.	286 lb. groundnut cake	each	20 lb. N.
142 A. 147 A.	286 lb. groundnut cake 111 lb. superphosphate	each	20 lb. N. 20 lb. $P_2 0_5$
142 B. 147 B.	286 lb. groundnut cake	each	20 lb. N.
143 A. 148 A.	111 lb. superphosphate 50 lb. sulphate of potash	each	20 lb. $P_2 0_5$ 20 lb. $N_2 0$
143 B. 148 B.	286 lb. groundnut cake 111 lb. superphosphate 50 lb. sulphate of potash	each	20 lb. N. 20 lb. $P_2 0_5$ 20 lb. $N_2 0$

The dadaps in plots 144 and 149 have been cut down to a height of 7 feet as they were growing too high.

The two dadap plots Nos. 144 planted with dadaps in 1912 and plot 149 planted in 1904 continue to show improvement and are not being otherwise manured except with the 100 lb. Basic slag and 60 lb. Sulphate of potash applied at each pruning.

The Albizzia plot No. 150 also maintains a high yield but does not show further improvement.

The average yield per annum for two yearly periods since 1910 are:—

	Plot 144 Dadaps	Plot 149 Dadaps	Plot 150 Albizzia.
1910 & 1911	1075 lb.	1582 lb.	1162 lb.
1912 & 1913	1021 lb.	1511 lb.	1252 lb.
1914 & 1915	1290 lb.	1757 lb.	1141 lb.
1916 & 1917	1363 lb.	1770 lb.	1179 lb.

EXPERIMENT STATION TEA PLOTS.

Actual yield of Green leaf per plot during the years 1915, 1916, and 1917.

Plot	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	
Jat of bushes	Singlo Indigenous			Assam Hybrid (Horagala)		Manipuri Indigenous (Kotiyagala and Norwood)					Singlo		Assam Hybrid			Rainfall
Year																
1915	1790½	1864	1725	2901	3057½	4635	4273	3752	6270	5786	1082	1012	1118	1129	2269	87·59
1916	3283	4014	3336½	4563½	5260	3918¼	3935¼	3405	4726½	5086½	1084	970	878	895	5340½	84·06
1917	2028	2242	2067	3140	3016	5026	4996	3894	6761	6127	—	—	—	—	3548	99·46

Abstract of yield of Made Tea estimated at 24·15 per cent. of the fresh leaf.

Plot	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	Rainfall
Year	Soluble manure mixture 100 lb. for last time 1909	Soluble manure mixture 100 lb. Indifera 1909	Prunings buried	Dadaps planted, 1912			Crotalaria uprooted in Nov. 1910	Crotalaria unrooted in Nov. 1910	Dadap plot	Albizzia plot	Crotalaria 1910				Cattle manure, Mar. 1908	
1915	432	452	417	701	740	1118	1034	910	1518	1394	248	245	270	267	549	87·59
1916	792	970	814	1105	1272	940	950	826	1142	1228	265	234	212	216	1290	84·06
1917	490	545	499	758	728	1213	1106	940	1632	1479	—	—	—	—	856	99·46

SOILS AND MANURES.

THE GROWTH OF INTERNATIONAL TRADE IN MANURES AND FOODS.

PROF. JAMES HENDRICK, B.Sc., F.I.C. UNIVERSITY OF ABERDEEN.

There are few people who realise how great is the international trade in manures and materials which go to make manures, and what enormous strides it has made during the past few years. Many know that there is an immense volume of trade in foods, which employs millions of tons of shipping; and we have all been brought during the past few months, under the perils of the world war, to realise the vital importance of this trade to the United Kingdom. There are still many, however, who seem to think that we have depended since time immemorial on overseas sources for our food supplies, and who neither understand the extent to which this trade has developed since the last great world war was fought, just over a century ago, nor how unprecedented are the present conditions of food supply, especially in this country, nor how greatly these new conditions have modified our military position and security. The present enormous volume of international commerce in manures and foods is practically a growth of the last century, and mainly of the last fifty years.

It is the intention to deal in this paper especially with the trade in manures ; but manures and foods have been taken together since they are very closely interrelated, and even, to a certain extent, interchangeable. When the farmer applies manures to the soil, he does so to increase his crops—that is, to increase the quantity of food raised from his soil. Therefore, if we import manures, we do so to increase the volume of food produced in the country ; and by importing manure we increase the national supply of food and render it unnecessary—other things being equal—to import so much food. Also, the weight of fertilising material is not nearly so great as the increased weight of food which is raised by its aid ; and thus by importing fertilising materials, up to a certain point we save shipping, for a far smaller tonnage will carry the manures than would be necessary to carry a weight of food equivalent to the increase which we expect to obtain by the use of the manures.

Conversely, when we import foodstuffs, we are importing manurial material, for every foodstuff has a certain manurial value, and when imported from abroad it brings to our shores manurial constituents drawn from the soil of the country where it was grown. No doubt much of this imported foodstuff is consumed in towns, and its manurial value is squandered down our sewers into the sea; but certain parts—such as the offals derived from the milling of cereals, and the oil-cakes obtained from the crushing of oil-seeds—are used to feed stock, and the manurial value is, or should be, largely recovered in the dung of the farm. Hence farms which consume much imported foodstuff should not require to consume so much imported manure.

For many years we have been, in a general way, conscious of the importance of our overseas commerce in foodstuffs, and of the danger which would arise in case of war if our importation of foodstuffs should be interfered with; but neither our statesmen nor the people, except in the case of a few exceptional individuals, had knowledge, foresight, and imagination enough to realise adequately the position, or to take in advance the measures which might have been taken to provide safeguards against the dangers which have now arisen. This lack of foresight and technical knowledge has been shown not merely in regard to the direct supply of foodstuffs from abroad, but in the failure to safeguard the supply of manures by which the produce of our land at home is maintained, and to foster and promote the increased use of manures by which the produce of our soil is increased. For instance, to take only two examples, the outbreak of war found us almost entirely dependent on Germany for potash manures, and little or nothing had been done in the past to explore and develop home sources of potash compounds; and in recent years industries have been developed in other countries for the preparation of synthetic nitrogen compounds, the world-wide importance of which has, in nearly all great industrial and agricultural countries except Britain, attracted the intense attention of statesmen and capitalists. Here these new industries have merely been smiled at as the play of theorists and men of science.

MANURES.

Early History.—There has always, since international commerce existed at all, been international trade in foodstuffs, and, especially in earlier times, in the more expensive and less essential foodstuffs, but international commerce in fertilisers may be said to have originated about 1840. Before that date the bulky and locally produced dung and lime were almost the only fertilisers. A certain amount of trade in bones existed before that date, and there was probably a small amount of trade in other refuse materials of animal origin and in oil-cakes which were used as manure. By 1840 agricultural chemistry had made considerable progress. Much had already been learned as the requirements of plants and as to the sources from which they derived the constituents which they needed. The time was ripe for practical applications of the knowledge which had been gained, and the necessary scientific stimulus was given by the great German chemist Liebig, who propounded his theory of manuring, which attracted much attention and led to much discussion and experiment. At the same time, the introduction of Peruvian guano supplied a concentrated manure of a unique kind which more readily attracted the attention of practical agriculturists than purely chemical substances like superphosphate and ammonia salts, which began to be used about the same time.

Guano is said to have been used in Peru as a fertiliser before Europeans discovered America. It was first brought to Europe about 1804 by the famous traveller Humboldt,* but it was not till 1839 that it began to be imported in bulk. Its use was a revelation to people who had been accustomed only to bulky manures like dung, or to slow-acting manures like bones. There is no manure on the market at the present day of such all-round excellence as the

* Sir Humphry Davy in his Elements of Agricultural Chemistry, 1813, mentions guano as "the manure that fertilises the sterile plains of Peru," and states that he had tried experiments with some specimens sent to the Board of Agriculture in 1805.

Peruvian guano, which was obtained from the Chincha islands, and contained about 14 per cent. of nitrogen, together with 20 per cent. or more of phosphates and a little potash. It contained these constituents in a highly available state, much of the nitrogen, phosphate, and potash being water soluble, and the remainder in readily available forms. It was also in its favour, in the estimation of ordinary farmers, that it was a natural manurial material derived mainly from the dung of sea-birds. Birds' dung has been held in high regard since time immemorial as a fertiliser, and the fact that this wonderful new manure was composed of birds' dung, and had a strong manurial smell, undoubtedly helped it to come rapidly into favour among farmers. Be that as it may, no concentrated manure ever sprang more rapidly into extensive use than guano,* and that with a generation quite unfamiliar with concentrated manure. Its introduction did more to accustom farmers to the idea of concentrated fertilisers and their use than anything else could have done. Naturally, it met with opposition and ridicule, but still people tried it, and probably no amount of writing and teaching could have so rapidly taught the agricultural public a great new lesson in the use of manures as did the placing of guano on the market. Its opportune introduction probably did more to advance the use of concentrated manures throughout the country than all the work of the early experimenters and all the writings of the agricultural scientists of the period.

It is difficult to get accurate figures of the production and consumption of fertilisers in the early period of the industry, and in the case of many manures it is not till after 1880, or even after 1900, that any complete statistics are available. Before that time the main deposits of Peruvian guano were worked out. It is said that so rapidly did the use of guano increase that by 1855 over 400,000 tons per annum were exported from South America, of which about 200,000 tons were used in the United Kingdom. Some estimates placed the consumption in the United Kingdom much higher. During the height of the Peruvian guano trade the export reached about half a million tons per annum, but as the deposits were limited, they soon began to be worked out, and after 1870 the industry began to decline. Even in 1855, Dr. T. H. Way, chemist to the Royal Agricultural Society,† stated. "Although importations of guano are enormous, the supply is not always equal to the demand." It is interesting to note, however, that according to the prices he gives for manures in that year, guano was much cheaper per unit of nitrogen than either nitrate of soda or sulphate of ammonia, and much cheaper per unit of phosphate than bones, ground coprolites, or superphosphate. Though other parts of the world were ransacked for guano, and deposits were worked in many places other than Peru, the industry fell away to comparatively small proportions after 1880. The Peruvian guano industry was the first international manure industry which involved a great overseas commerce, and employed a large fleet of ships.

Meantime other manure industries, which were destined to reach even greater dimensions and to be more permanent, had been founded and were

* John Shier, in his edition of Davy's Elements of Agricultural Chemistry, published in 1844, gives a long account of guano, which, he states, "within the last few years has been largely imported into Britain, and.....it is generally esteemed the most valuable of extraneous manures."

† Journal Royal Agricultural Society, XVI, 540, 1856.

gradually extending. Of these, the most important was the dissolved phosphate industry. In 1836, Liebig suggested the dissolving of bones by acid in order to make them more available to plants. According to Smetham,* Messrs. T. and H. Proctor of Bristol entered into communication with Liebig and Boussingault, and began, before 1840, to place dissolved phosphates, made from bones, bone ash, and bone black, upon the market. Soon afterwards Lawes began to dissolve ground coprolites, and started at Deptford the first factory for the manufacture of mineral superphosphate. This new industry at first grew slowly, as it was quite eclipsed by the rapid rise of the guano industry; and it was not till the supplies of guano began to fail that the manufacture of mineral superphosphate increased to really great proportions, and that a world-wide trade in raw mineral phosphates for the manufacture of superphosphate arose.

It was about 1840 also that the use of ammonium salts as manure gradually arose, and about the same time nitrate of soda, which was already being imported into Europe from South America for other purposes, began to be tried as a fertiliser. The use of these increased slowly during the period when guano was the supreme concentrated manure.

This early period in the use of artificial manures extended from about 1840 and during it, though much experimental and scientific work was carried out on the Continent. Britain was the great home of the manure industry, and was the pioneer and most extensive user of artificial manures. During this period our knowledge of the requirements of plants and of the effects of manures was greatly extended,—in Britain by the work of the Rothamsted Experiment Station, founded and carried on by Sir John Lawes, and by the experimental work carried on under the auspices of the great Agricultural Societies and by many private individuals; and on the Continent by the many Agricultural Research Stations and Agricultural teaching institutions which had arisen mainly with state support. During this period Britain was also supreme in the practice of agriculture, and was looked up to by other countries, not as at present merely as the great breeding-place for pure-bred stock, but as the leading exponent of good arable farming.

While it is difficult to get any accurate statistics of the increase in production per acre which took place about the middle of the nineteenth century owing to the use of guano and other concentrated manures, evidence is given in the writings of the period that such increases, which have been estimated at 50 per cent. did take place. Thus the distinguished agriculturist and President of the Royal Agricultural Society of England, Philip Pusey, in his last published paper,† gives the following quotation from a Norfolk corn-dealer's circular: "The yield of wheat has gradually increased during the past four years, mainly through the use of artificial manures used as top-dressings, that it is difficult to define what is an average crop;" but Pusey himself adds, "Over the greater part of England no one would say that this practice, even if known, has become an ordinary act of husbandry." He then goes on to make the statement that if our "French neighbours and friends" would adopt the practice, it would be an "easy method of preventing deficient crops from which France has lately suffered." This seems to

* Jour. Socy. Chem. Ind. XVII, 900, 1898.

† Journal Royal Agricultural Society, XVI, 532-3, 1856.

indicate not only that an increase of crop might be obtained by the use of artificial manures, but that these were not used in France as they were, in parts at any rate, of Britain.

From the beginning of the nineteenth century Britain was looked up to by Germany and other Continental countries as the home of good arable farming, and probably no part of Britain had a greater reputation in this respect than the South-East of Scotland. After the introduction of artificial manures crop production seems to have increased considerably in those parts of the country where these manures were used, and for all the period from the beginning of the century up till, at any rate, 1880 we retained a high reputation for production per acre of all the leading crops we grow.

After 1880 the great period of agricultural depression set in, and arable farming began to decline in Britain. It is not the purpose of this paper to deal with the decline of agriculture in Britain and its causes, but the result has been that, in the modern period between 1880 and the present day, when the fertiliser industry rapidly grew to a great world industry, employing immense numbers of people in the mining, manufacturing, and transport of fertilising materials, Britain has only developed slowly as a manufacturer and user of artificial manures, and has been overtaken and passed by other countries, till now we occupy a quite secondary place in the world's fertiliser markets, in which at one time we were supreme. The enormous increases which have taken place in the production, transport, and consumption of fertilisers have been due almost entirely to the rapid advance of other countries, and this, as will be shown later, has re-acted on our crop-producing capacity as compared with others. It is not so much that we have gone back, as that others have gone forward rapidly, while we have relatively stood still and allowed them to pass us. Several countries which started much behind us have now caught us and passed us by as manufacturers, importers, and users, of fertilisers, and, consequently, as producers of crops.

We may next take in order the leading artificial manures, and trace the growth in their production and use, so as to bring out how rapidly the fertiliser industry has been developing, especially since the beginning of the twentieth century. As has been already pointed out, the industry increased only gradually, except in the case of Peruvian guano, till after 1880, and was chiefly a British industry. After 1880 other countries rapidly came to the front as users of fertilisers,—first, the leading countries of Western Europe, Germany, France, Belgium, Holland, etc., in which there were well-developed systems of agricultural education and research, began to reap the fruit of the systematic training of their people in agricultural science, which along with other factors, led to a very rapid increase in the consumption of fertilisers; second, new countries like the United States, which had paid little attention to fertilisers so long as they had plenty of virgin soil to break up, began to pay attention to the subject, and have rapidly become great manufacturers and users of artificial manures; and third, ancient Eastern countries like Japan and India have become important markets for fertilisers.

In recent years it has become easy to obtain statistics of the international use and production of manures, since the International Institute of Agriculture, Rome, collects and publishes such figures. These are to be found in the half-yearly reports on "The International Movement of Fertilisers," published

in the September and March numbers of the "Monthly Bulletin of Agricultural Intelligence and Plant Diseases," issued by the Institute, and in the "Annuaire International de Statisque Agricole," issued by the Service de la Statisque General of the Institute. The Bureau of Agricultural Intelligence and Plant Diseases of the Institute, also issued in 1913 a pamphlet entitled "Production et Consommation des Engrais Chemiques dans le Monde." All these publications have been drawn upon for the statistics which follow.

The admirable statistics issued by the International Institute, however, take us back, as a rule, only to 1903 or 1905. The Institute was itself established under International treaty in 1905. If earlier information is wanted, it has to be collected with much trouble, from a great many sources, both official and unofficial. Many such sources have been drawn upon for what follows. The further one goes back the more difficult it is, as a rule, to get reliable figures. Great Britain also has not distinguished itself in the past, in comparison with some other countries, for the laborious and accurate compilation of industrial statistics, though a great improvement has been effected in recent times.

The three great classes of artificial manures—nitrogenous, phosphatic, and potassic—will be taken in turn.

NITROGENOUS MANURES.

When the use of concentrated nitrogenous manures began about 1840, nitrate of soda was already being imported from South America. Early trials showed its great value, and though it did not impress the popular imagination like guano, it came steadily and increasingly into use. The following table, prepared from figures kindly supplied by the Chilian Nitrate Committee, gives the average annual export from South America for five-yearly periods from the start of the industry to the present day. The official figures are given in Spanish quintals, and have been converted into tons (22 Spanish quintals equal to 1 ton).

TABLE I.

AVERAGE EXPORT FROM CHILI FOR FIVE-YEARLY PERIODS.

Year.	Tons.	Year.	Tons.
1830-1834	3,201	1876-1879	243,069
1835-1839	6,759	1880-1884	332,828
1840-1844	14,684	1885-1889	667,145
1845-1849	18,770	1890-1894	929,255
1850-1854	29,641	1895-1899	1,206,300
1855-1859	51,259	1900-1904	1,340,636
1860-1864	72,667	1905-1909	1,821,845
1865-1869	105,400	1910-1914	2,344,627
1870-1874	207 519	1915	1,999,272
1875-1879	243,069	1916	2,944,909

It will be seen that there is an increase in export each five-yearly period. At first the increase is comparatively slow, and it is not till the period 1865-69 that the average export passes 100,000 tons. Then the increase is somewhat more rapid till after 1880, when once more the pace increases, and continues very rapid till the present day.

Up to 1870 the United Kingdom was the great consumer of nitrate of soda, and took far more than all other countries put together. The Chilian

Nitrate Committee was formed in 1889, and it has not been found possible to obtain any complete statistics of the world's deliveries for consumption of nitrate of soda before that date. In 1873, 124,000 tons of nitrate were imported into the United Kingdom, and the total export from Chili was 284,717 tons, which was much over the average for the ten years from 1870 to 1879. In other words, at this period the United Kingdom still took about half of the total nitrate exported from South America. The great expansion in consumption which has taken place is shown in the next table, in which "deliveries for consumption" is shown at intervals of five years, from statistics supplied by the Chilian Nitrate Committee.

TABLE II.

NITRATE OF SODA.

DELIVERIES FOR CONSUMPTION.

Year.	Tons.	Year.	Tons.
1889 ...	734,860 ...	1909 ..	1,922,000
1894 ...	987,550 ...	1913 ...	2,464,540
1899 ...	1,344,550 ...	1914 ...	2,181,646
1904 ...	1,429,150 ...	1915 ...	1,731.910

The greatest consumer of nitrate is now Germany, though the United States has been coming up rapidly during recent years; but probably the greatest consumer per arable acre before the war was Belgium, which little country consumed more than the whole of the United Kingdom. The following Table, III., shows the approximate consumption (import less export) of nitrate by certain countries for the years 1905 and 1913, and is derived from the statistics of the International Institute of Agriculture.

TABLE III.

NITRATE OF SODA.

Consumption in Different Countries. (Import less Export).

	1905 Metric tons.	1913 Metric tons.
United Kingdom ...	99,311	143,187
Belgium	143,426	164,145
France	226,753	316,847
Germany	520,386	746,791
Italy	46,093	67,368
Holland	37,238	82,490
United States ...	326,386	635,905

The above statistics show that the United Kingdom was already consuming about 100,000 tons of nitrate in the seventies, and table III shows that this rate of consumption had not been seriously increased right up to the eve of the outbreak of the present war. On the other hand, Continental countries, and especially Belgium, France, and Germany, have increased their consumption at a very rapid rate, as has also the United States.

For a long period the only serious rival of nitrate of soda as a concentrated nitrogenous manure was sulphate of ammonia. Ammonia compounds were experimented with as fertilisers early in the nineteenth century. A small supply of these salts was already being produced before 1840 from the ammoniacal liquor of gas-works, and ammoniacal liquor itself had been tried as a manure. About 1840 sulphate of ammonia had not yet established its

position as the standard form in which ammoniacal salt was to be used for agriculture. Thus we find that in the Rothamsted experiments both sulphate and muriate of ammonia were used. In other early experiments carbonate of ammonia was also tried. After a time, however, it was found that the sulphate was the most cheaply and readily prepared salt of ammonia, and it has for a long period now been practically the only salt of ammonia used as manure.

For many years after 1840 the production of ammonium salts was small, and little was used for agricultural purposes. Up to 1880, or even 1890, the manufacture of sulphate of ammonia appears to have taken place mainly in Britain, in which country also most of it appears to have been consumed. Since 1880 the growth of the industry has been rapid, and Germany and the United States have become large producers, while many other countries, notably France, Belgium, and Austria-Hungary, produce considerable quantities. Table IV shows the production of the chief producing countries—the United Kingdom, Germany, and the United States—for every fifth year up to 1910, and yearly after that date. Most of these figures were kindly supplied by Messrs. Bradbury and Hirsch, Liverpool, and by the Sulphate of Ammonia, Committee, London, but some of the later figures are taken from statistics published by the International Institute of Agriculture. (N.B.—All figures quoted from the returns of the International Institute are in metric tons of 1,000 kilos. equal to 2205 lb.)

TABLE IV.

PRODUCTION OF SULPHATE OF AMMONIA.

	United Kingdom.	Germany.	United States.
	Tons.	Tons.	Tons.
1870	40,000	—	—
1875	46,000	—	—
1880	60,000	—	—
1885	97,000	—	—
1890	134,000	—	—
1895	171,000	about 50,000	—
1900	213,000	130,000	24,600
1905	268,500	190,000	69,250
1910	367,500	373,000	105,140
1911	385,000	418,000	115,245
1912	388,000	492,000	149,700
1913	432,000	549,000	176,900
1914	426,000	—	166,010
1915	426,000	—	220,000
1916	438,000	—	—

It is to be remembered that all these figures are more or less accurate estimates, and that figures published by different authorities differ slightly from one another.

The Chemical World for January, 1912, stated the world's production of sulphate of ammonia, as follows :—

	Tons.		Tons.
1860	2,000	1905	625,000
1900	450,000	1910	1,100,000

The International Institute of Agriculture gave the world's production for 1913 as 1,412,032 metric tons.*

Germany overtook the United Kingdom as a producer of sulphate of ammonia in 1910, and just before the war had passed us by over 100,000 tons per annum. Since the outbreak of war there is every reason to believe that the production in Germany has been very greatly increased, mainly, by the development of the HABER process for the synthetic production of ammonia from nitrogen obtained from the atmosphere. Reports which have reached this country, and which may not be very trustworthy, state that in 1916 Germany produced ammonia equivalent to neary a million tons of sulphate of ammonia.

Before the war the United Kingdom was by far the greatest exporter of sulphate of ammonia. We exported practically three-fourths of what we produced, and imported none, therefore only about one-fourth of our production was used at home for all purposes. While the principal use was as a fertilizer, this was by no means the only use of sulphate of ammonia. From 1900 to 1914 the amount of sulphate of ammonia consumed in the United Kingdom for all purposes was estimated by MESSRS. BRADBURY and HIRSCH at from 65,000 to 97,000 tons per annum, while we exported to many countries, and especially during recent years, to Japan, Spain, the United States and Java.

On the other hand, other countries, and in particular Germany, consumed most of what they produced. At one time we exported a large amount of sulphate of ammonia annually to Germany, and as late as 1905 Germany imported more than she exported, and the same was true of that intensively manured and cultivated country, Belgium. It is estimated that in 1900 Germany consumed 126,000 tons; in 1910, 350,000 tons; and in 1913, 500,000 tons of sulphate of ammonia. The United States consumed the whole of what she produced, and was also a large importer from 1910 onwards; and Japan in recent years has been the greatest importer of all, importing in each of the years 1913 and 1914 over 100,000 tons, and, in addition, consuming the whole of the small supply produced at home. It is evident, then, that as in the case of nitrate of soda, so in the case of the still more concentrated nitrogenous manure sulphate of ammonia, we have been far surpassed as consumers by other countries.†

One of the most important developments in connection with nitrogenous manures during the twentieth century has been the development of the manufacture of synthetic nitrogenous manures from the nitrogen of the atmosphere. As the above statistics show, the world's consumption of concentrated nitrogenous manures is increasing at a very rapid rate. Though the known supplies in the nitrate beds of Chili are very large, still, if the consumption goes on increasing at its present rate, they will be exhausted in a comparatively limited space of time. The estimates of the available supplies of nitrate of soda in these beds, and of the time which they will last, vary very greatly, but even the most optimistic estimates indicate that exhaustion

* Monthly BULLETIN OF AGRICULTURAL INTELLIGENCE AND PLANT DISEASES, March 1915, p. 332.

† In 1916, war conditions caused a large increase in the consumption of sulphate of ammonia in the United Kingdom, and it is probable that in 1917 the consumption will increase still further. It is estimated by MESSRS. BRADBURY & HIRSCH that the consumption in 1916 was 178,500 tons.

will begin to be felt at no very remote period if the agriculture of the world is to continue to develop in the future as it has been doing during the past thirty years. No doubt the supplies of sulphate of ammonia obtained from coal, and produced synthetically, can be, and will be, greatly increased. Yet it is obvious that not only is it necessary to look ahead and consider the requirements of the future, but that there is a great opportunity for the exploitation of new nitrogenous manures, and that the possibilities for the discoverers of workable commercial processes for preparing such manures are limitless. Consequently, many minds were applied to this problem in Britain, as well as in other countries, but with this difference, that in Britain only scientific work was done upon it, and in commercial and financial circles it attracted little or no serious attention. On the other hand, in countries such as Germany and America, not only were able scientific workers engaged upon the subject, but they were encouraged and supported by capitalists who had a sufficiently wide outlook to realise the world-wide commercial possibilities of a successful process. Several processes have now been devised, and are working on a large scale. To treat of these would require a separate paper, but already before the war two processes, at any rate, had become subjects for international commerce on a considerable scale. These are the Kirkeland and Eyde process for the manufacture of nitrates, and in particular nitrate of lime, and the cyanamide process. In both of these processes the atmosphere, in which there are unlimited free supplies, is used as the source of nitrogen, and cheap supplies of electric energy, generally obtained from water power, are also made use of. The cyanamide manufacture is carried out in many countries, while the nitrate of lime process is practically confined at present to Norway. Calcium cyanamide, which is commonly known in this country as nitrolim, began to be produced in commercial quantities early in the present century in Germany and Italy. It is difficult to get accurate figures for the actual production, but Table V gives figures for 1910 and 1913, taken from statistics published by the International Institute of Agriculture.*

TABLE V.

PRODUCTION OF CALCIUM CYANAMIDE (NITROLIM).

(Metric Tons.)

	1910.	1913.
Germany	11,500	24,000
Austria-Hungary ...	—	7,500
France	1,000	7,500
Italy	3,715	14,980
Norway	4,280	22,110
Sweden	—	18,350
Switzerland	—	7,500
United States and Canada ...	—	48,000
Japan	—	7,000
Total ...	20,495	156,940

This table shows the rapid increase in the number of producing countries and in the amount produced. None is produced in the United Kingdom, which obtains the small amount which it consumes from Norway.

The production of synthetic nitrate of lime was, before the war, confined to Norway, and the rapid increase in production is shown in table VI.

* Annuaire Internationale de Statisque Agricole, 1913 et 1914, p. 679.

TABLE VI.

PRODUCTION OF NITRATE OF LIME IN NORWAY.

(Metric Tons.)

Year.	1905.	1906.	1907.	1908.	1909.	1910.	1911.	1912.	1913.
Metric tons.	127	1,181	1,601	5,102	11,953	18,569	13,152	36,468	73,214

Most of the nitrate of lime produced by Norway was, before the war, exported to Germany. Since the outbreak of war this has been a most valuable source of nitrate to that Country, which normally imported such great quantities of nitrate of soda from Chili, and has been almost entirely deprived of that valuable material for more than two years. The nitrate industry in Norway also produces nitric acid and nitrate of ammonia, both substances most valuable and necessary to Germany for munition purposes, and this new source of supply must have been of incalculable value to our enemies during the present conflict. It is also understood that, since the outbreak of war, Germany has manufactured great quantities of synthetic nitrates and nitric acid in her own country for the supply of her munition factories and her agriculture. Our great enemy is being well repaid for the earnest attention her men of science and her capitalists gave before the war to the development of synthetic processes for the manufacture of nitrogen compounds.

The International Institute of Agriculture does not give separate returns for the export and import of cyanamide and nitrate of lime, but classes all synthetic nitrogenous manures under one head in the statistics of export and import. There are few figures for import given till 1912, and the following Table (VII.) shows the imports in that year and 1913 for the chief importing countries :—

TABLE VII.

IMPORTS OF SYNTHETIC NITROGENOUS MANURES.

(Metric Tons).

	1912.	1913.
France	3,160	10,010
Germany	44,612	72,257
Russia	2,244	2,326
United States	7,248	14,891

It will be seen that Germany was by far the most important importing country. Unfortunately statistics are not available since the outbreak of war.

Norway, on the other hand, is the chief exporting country for synthetic nitrogenous manures, as she exports most of what she produces. The exports of Norway during the past few years are given in Table VIII., which shows that the industry in synthetic nitrogenous compounds is rapidly becoming a very valuable one for Norway.

TABLE VIII.

EXPORTS OF SYNTHETIC NITROGENOUS MANURES FROM NORWAY.

(Metric Tons).

	1910.	1911.	1912.	1913.	1914.
Nitrate of lime	13,531	9,805	51,700	70,927	75,034
Nitrate of ammonia ...	—	3,023	4,270	9,107	11,941
Cyanamide	4,281	13,182	13,892	22,111	14,688

Germany and Sweden are also considerable exporters of calcium cyanamide.—Transactions of the Highland and Agricultural Society of Scotland, 5th Series, Vol. xxix, 1917.

(To be Continued.)

INFLUENCE OF THE FINENESS OF DIVISION OF PULVERIZED LIMESTONE ON CROP YIELD.

A correspondent who sends us the following extract from the Scientific American states that only a percentage of the coral burnt lime supplied to estates would stand the 40 mesh test.

Two samples tested, No. 1, from a European firm of manure dealers, No. 2, from a native firm.

No. 1, gave the unusual low percentage of 9 per cent. unburnt coral lumps, No. 2, turned out 35 per cent. Betwixt and between would be about the usual percentage.

One can always detect where lime has been applied by the coral on the surface, years after application.

The cost of sifting or grinding should be commensurate with the benefit derived.

Extract referred to.

An increase of the fineness of division of powdered limestone, added to soil, from 20 to 40 mesh, 100 to 200 mesh to finer than 200 mesh produces a proportional increase in the yield and total nitrogen content of crimson clover on several types of soil. The finer the division of the limestone the more rapid is the neutralization of the soil acidity and the greater the increase in the activity of the bacteriological processes of ammonification, nitrification and nitrogen-fixation. In the case of barley, buckwheat, and rape, fine limestone without supplementary addition of nitrogen fertilizers, gives as high a yield as coarse limestone with an application of 600 lb. of ammonium sulphate per acre; 200 mesh limestone may be regarded as being as effective as burnt lime.—Note in the Journal of the Society of Chemical Industry on an article by N. Kopeloff in Soil Science.

MAINTAINING THE NITROGEN SUPPLY OF THE SOIL.

A. W. BLAIR.

A general discussion of the soil nitrogen supply and its maintenance is followed by the results of an eight-year experiment in which wheat and rye were grown continuously on one-twentieth-acre plots of sandy loam soil with and without a leguminous green manure crop of cowpeas and soy beans grown between the time of harvesting the grain crop and the fall seeding of the following crop. While the yields of wheat and rye were small on all plots, those on plots receiving green manure treatment were from 50 to 100 per cent. greater than those without green manure treatment.

The average yields for the legume plots and also those without legumes for the last four years were smaller than the corresponding averages for the entire eight years. This is taken as an indication that the nitrogen supply of the soil is not being maintained even where the leguminous crop is grown. The average gain in nitrogen for the legume plots for the last four years, as indicated by the amount recovered in the crop, amounted to about 15 lb. annually.

It is suggested that farmers endeavour to maintain the nitrogen supply of their soils by growing leguminous crops either as a part of the regular rotation or as green manure crops between the main crops of the rotation as often as possible and that for the most crops they further supplement the nitrogen thus secured by the use of a few hundred pounds of a material supplying nitrogen in a readily available form.—Experiment Station Record, Vol. 37, No. 5.

THE FIXATION OF NITROGEN IN FÆCES.

E. H. RICHARDS.

In the course of a general study of the chemical changes taking place in the manure heap, a number of experiments were made with the object of determining the loss of nitrogen during the ærobic fermentation of urine, straw and fæces; in the case of the last, however, instead of a loss of nitrogen, appreciable gains were recorded, and this decided the writer to devote special attention to the subject of this article.

He states in the first place, that horse fæces contains materials capable of fixing nitrogen when fermented ærobically in presence of sufficient moisture and calcium carbonate. This fixation is a function of the diet, for when horses are fed on grass alone, instead of oats and hay, the amount of nitrogen fixed is much reduced. Under the most favourable circumstances, 1 gram of dry matter in the fæces will fix 4 mgms. of nitrogen. Bullock fæces will also fix nitrogen, but to a much smaller extent than horse fæces. This is also a function of diet, for it only occurs when the animals are fed with cake; on grass alone, no nitrogen is fixed.

The writer has found that the organisms concerned in the fixation of nitrogen are present in garden soil. Fixation is brought about by a mixed culture of *Azotobacter* and *B. lactis ærogenes*. Of these, the latter is normally present in fæces, and though *Azotobacter* is not, it readily infects fæces. The inoculation of fæces with both organisms fixes a considerable amount of nitrogen which disappears after sterilisation. Raw fæces, when inoculated with soil, also fixes nitrogen; this fixation power was retained after sterilisation in the autoclave in some experiments which gave the greatest increase in nitrogen. It therefore seems probable that the nitrogen fixation is only a last link in a chain of biological changes brought about by organisms normally present in the fæces or soil.

The practical importance of this fixation is probably small; at most it means that when a soil is manured with horse dung, there is a possible addition of atmospheric nitrogen, which may amount, under the most favourable conditions, to 30 per cent. of the nitrogen in the complete manure.

On the other hand, the discovery might be of practical use in increasing the nitrogen of the soil, by fixing atmospheric nitrogen on industrial bye-products containing actual or potential food for organisms of the types active in horse fæces.—BULL. OF INTERNAT. INST. OF AGRIC., September, 1917.

VALUE OF DUCK MANURE.

The high value of duck manure is recognised by those who have kept ducks, but does not appear to be appreciated by farmers generally. Upon this question scientific observation is needed, but those who keep large numbers of ducks bear testimony to the remarkable improvement in the herbage of pastures upon which the ducks have been thickly kept for one season, and their practical experience leads to the conclusion that the manurial effect is felt for three or four years. In some instances the number of birds kept is so large that the grass appears to be entirely eaten off, and the earth is quite bare; the grass, however, springs up luxuriantly the following year, the manure apparently favouring the finer grasses. Hence ducks may have an economic value in the improvement of pastures, apart from any profit which they may yield. Upon farms where fresh-ground can be used for the ducks annually they may take the place of larger stock, and avoid the necessity of using so much artificial fertilisers.—BULL. INTERNAT. INST. OF AGRIC., November, 1917.

GENERAL.

THE COMPARATIVE KEEPING QUALITIES OF PALM KERNEL, COCONUT, GROUND-NUT AND OTHER OIL-CAKES.

WILLIAM GODDEN.

(Department of Agriculture, the University, Leeds.)

One of the difficulties which hinder the extended use of the nut-oil-cakes (palm kernel, coconut and ground-nut) is the prevalent impression that these cakes deteriorate rapidly on keeping. In recent articles dealing with these cakes frequent reference has been made to this point. Thus Voelcker [9] in his Annual Report for 1914 states that "one inconvenience attaching to the palm-nut and coconut cakes is that they do not keep as well as linseed and cotton cakes and that there is a tendency for them to turn rancid." In his Report for 1915, however, he says, "I have come across but few instances either with palm-nut cake or meal, in which these have been rancid or not in good condition." Murray [8] states that manufacturers should realise that they still have to reassure farmers regarding the keeping qualities of palm kernel cake. In a later article in the Journal of the Board of Agriculture [3] it is stated that "palm-nut kernel cakes in the past have had the reputation of soon going rancid . . . At the present day before the kernels are crushed they are subjected to a process of cooking, by which the ferment that causes the oil to turn rancid is rendered inactive." The validity of this latter assertion seems doubtful in the light of the recent work of Calder [2] which shows that the lipase, present in the resting seed in the form of its zymogen, is not destroyed during the manufacture of the cake, the mass of crushed kernels not being sufficiently heated in every part prior to pressing to secure this object completely. Similar statements have been made as to the liability of coconut and ground-nut cakes to become rancid on storing. [3,4]

In view of these facts and of the endeavours which are being made to increase the use of these cakes in this country, it was thought advisable to re-examine the whole subject of the keeping qualities of these cakes and to compare them, in this respect, with other cakes, which are already widely used by British farmers. The three nut-cakes were therefore compared with linseed, undecorticated cottonseed, "soycot" and soya cakes, the cakes being kept

(a) under ordinary farm conditions in the cake store at The Manor Farm, Garforth;

(b) in the laboratory under conditions most likely to promote decomposition.

Of each particular kind of cake four adjacent cakes from the middle of a press were obtained fresh from the crushers. Of these four cakes, two were stored at Garforth in the cake store, stacked in the usual way alongside the cakes then being fed on the farm, whilst, of the other two, one was used for the laboratory trials and the other kept in reserve. When the cakes were sampled for analysis, strips about eight inches wide were taken from the middle of each cake, ground up, mixed separately and sampled by quartering in the usual way.

In addition to careful observation of the appearance, physical condition and other external characteristics of the cakes, the following points were examined :

(1) The changes in the composition of the cake with respect to (a) crude protein, (b) true protein, (c) oil, due allowance being made for the variation in the moisture content of the cake during storage.

(2) The increase in the amount of the free fatty acids in the oil during storage.

(3) The part played by the oil in any changes undergone by the nitrogenous constituents of the cake.

FARM TESTS.

The two cakes of each kind were put into the cake store on March 28th, 1916, the first cake being sampled on June 15th, and the second on September 13, 1916, by the method described above. The samples were thus obtained, roughly after three and six months storage respectively. The six months storage covered the whole of the summer months, the cakes thus being kept at temperatures very suitable for the activity of micro-organisms. The percentage composition of the dry matter of the cakes at each stage is given in Table 1.

At the end of the six months there was no sign of mould on any of the cakes nor was any unpleasant smell noticeable. The coconut cake had become quite soft and could be crumbled in the hand and was, therefore, difficult to handle. In view of the difficulty which Mackenzie and Powell [6] experienced in getting cattle to clean up coconut cake, even when it was mixed with cottonseed and linseed cakes, unless the coconut cake was in moderately big pieces, this softening would be an apparent objection to the lengthy storage of this cake. The palm kernel cake could be broken with moderate ease, whilst all the other cakes were still quite hard.

Table I.

Cakes stored at the farm.

Kind of cake.	Length of time stored.	Percentages calculated on the dry matter: Crude Protein.	True Protein	Oil.	Free fatty Acids as % of Oleic Acid in the Oil.
		%	%	%	%
Linseed	Nil	32·78	28·77	13·43	11·23
	3 months	31·19	28·07	13·46	18·07
	6 months	32·35	28·01	14·02	29·82

Kind of cake.	Length of time stored	Crude Protein	True Protein	Oil	Free fatty Acids as % of Oleic Acid in the Oil
		Percentages calculated on the dry matter			
		%	%	%	%
Ground-nut	Nil	34·08	31·21	11·27	14·65
	3 months	31·98	28·19	10·72	37·65
	6 months	32·99	27·92	10·25	56·02
Coconut	Nil	20·68	19·92	15·59	5·84
	3 months	20·29	19·42	14·46	45·39
	6 months	21·21	19·95	12·55	73·45
Palm kernel	Nil	19·49	18·88	10·38	5·70
	3 months	19·00	18·51	10·68	25·34
	6 months	19·02	19·01	10·76	40·93
Undecorticated cottonseed	Nil	25·55	23·69	5·33	61·48
	3 months	25·03	22·93	5·77	82·85
	6 months	24·99	23·85	5·47	87·44
"Soycot"	Nil	34·66	33·87	6·01	20·95
	3 months	36·01	32·91	6·04	37·42
	6 months	36·07	33·44	5·85	65·33
Soya	Nil	47·94	46·35	6·61	5·18
	3 months	48·75	46·79	6·90	8·80
	6 months	48·41	46·52	7·22	16·37

It will be seen that, with the possible exception of coconut cake, the cakes show no change in the percentage composition of their dry matter, beyond the limits of error due to sampling and the possible slight variation between the cakes as manufactured, during the six months storage. The one noticeable change, common to all the cakes, though in varying degree, is the increase in the amount of free fatty acids present in the extracted oil. In this connection the most striking feature is the high initial acidity in the case of the cottonseed cake, due to the fact, subsequently ascertained, that the cottonseed cakes used were made from a not very satisfactory sample of cottonseed from the notoriously bad crop of 1915. This explanation is borne out by the following data obtained from a number of samples of cottonseed cake examined very soon after their manufacture.

Table II.

Acidity of fresh Cottonseed Cake.

Kind.	Year of crop.	No. of Samples.	Oil (average) %	Free fatty Acids expressed as % of oleic acid in the oil		
				Max.	Min.	Average
Egyptian ...	1915	14	4·72	80·67*	11·44	34·71
Egyptian ...	1916	6	4·76	22·33	8·57	12·71
Bombay ...	1915	2	4·79	12·11	7·46	9·78
S. American ...	1915	1	3·80	—	—	13·84
Soudanese ...	1915	1	4·27	—	—	7·32

The final acidities, as shown in Table I, are all high, even the soya cake, which is the lowest, having an acidity more than three times the initial value. Leaving out of consideration the abnormal case of cottonseed cake the

* Described by the crushers as made from the oldest seed of a very poor crop.

highest final acidity is shown by the coconut cake, which also shows the greatest relative increase, the lowest relative increase being given by linseed cake. If this final free acidity be taken as a measure of the keeping qualities of the cakes then, after soya and linseed cakes, palm kernel cake is the most satisfactory. These results would indicate that the presence of a fat splitting enzyme is common to all the oil-cakes and cannot be adduced as a specific disadvantage of palm kernel cake.

It is difficult to say just what practical significance should be attributed to this increase in acidity. The presence of appreciable quantities of free fatty acids in a feeding-stuff is commonly regarded as undesirable but, provided the acidity be not so high as to cause actual derangement of the digestive functions, it is at least doubtful whether the nutritive value of the oil is seriously lowered by this liberation of the fatty acids present in it. Such direct evidence as is available points at least to this conclusion. Thus in experiments carried out by Munk (7) equally good results were obtained whether mixed fatty acids were fed as much or in the form of their glycerides, the results indicating that the animal body is capable of building up neutral fat from these free acids and depositing them in the body.

LABORATORY TESTS.

For the purpose of the laboratory experiments a strip from the middle of each cake was used. This was ground as finely as possible, a sample drawn for immediate analysis, and then lots of 200 grams of each cake taken and incubated under the following conditions:

Exp. 1. The ground cake was placed in a wide-mouthed bottle, 8 % of water was mixed in with it, the bottle loosely corked, and the whole incubated at 37° for twenty-six days.

Exp. 2. Similar to Exp. 1. The cakes were weighted before and after incubation.

Exp. 3. In addition to the 8 % of water, 5 c.c. of toluene were added to each cake in order to prevent mould formation.

It will be noted that, in each case, the cakes were kept in a confined space, in moist condition and at a relatively high temperature, conditions which may be regarded as likely to ensure a severe test of keeping properties.

During the periods of incubation in experiments (1) and (2) the first cake to show mould was the "soycot," which was distinctly mouldy at the end of two days. This was closely followed by cottonseed, ground-nut and soya cakes in the order named. At the end of four days the palm kernel and coconut cakes, though showing no signs of mould formation, had an ethereal and at the same time a somewhat cheesy smell. At the end of the period of incubation the four first-named cakes were mouldy throughout the whole mass, the "soycot" and soya cakes having a smell resembling that of fish meal. The linseed cake showed a development of mould at one spot but, apart from a slightly mouldy smell, no other change was apparent. Neither the palm kernel nor coconut cakes showed any sign of mould formation, but a cheesy smell was intensified in the case of the former. During the incubation in the presence of toluene (Exp. 3) there was no development of mould on any of the cakes, nor was there any noticeable change in appearance or smell.

As in the case of the cakes stored at the farm, the oil extracted after incubation shows a much higher free fatty acid content than before, the rise in most cases being of the same order as that found in the farm tests. The one exception is the soya cake where the rise is much greater as a result of incubation in the moist state than from storing at the farm, this difference being due probably to the fat-splitting action of the moulds formed on the cake during incubation. In contrast with the results obtained in the farm tests a marked decrease in the percentage of oil in the dry matter was found with all the cakes, except coconut cake. There is a marked rise in the percentage of "crude protein" in the dry matter of the "soycot" and soya cakes and to a lesser extent in the cottonseed and ground-nut cakes, During incubation in the presence of toluene (Exp. 3) there is no apparent change in the percentage composition of the dry matter of any of the cakes examined.

TABLE III.

INCUBATION OF MOIST CAKES AT 37°.

Kinds of Cake.	Before or after Incubation.	Percentages calculated on the dry matter. Crude Protein.	True Protein.	Oil.	Free fatty Acids as % of Oleic Acid in the Soil.
		%	%	%	%
Linseed	Before	32·78	28·77	13·43	11·23
	After (1)	33·11	30·59	9·33	56·90
	After (2)	32·83	28·88	11·18	70·50
	After (3)	32·53	28·30	13·40	36·50
Ground-nut	Before	34·08	31·21	11·27	14·65
	After (1)	37·35	34·85	4·27	71·40
	After (2)	35·95	34·23	3·93	68·60
	After (3)	32·44	31·06	10·84	62·50
Coconut	Before	20·68	19·92	15·59	5·84
	After (1)	21·25	19·78	14·72	64·10
	After (2)	20·89	19·55	15·84	61·20
	After (3)	20·37	20·08	15·65	75·40
Palm Kernel	Before	19·49	18·88	10·38	5·70
	After (1)	20·13	19·51	2·95	58·90
	After (2)	19·54	19·22	4·44	64·30
	After (3)	19·19	18·87	9·99	65·70
Undecorticated cottonseed.	Before	25·55	23·69	5·33	61·48
	After (1)	27·59	25·95	1·07	68·70
	After (2)	28·16	25·89	0·58	71·40
	After (3)	25·00	23·58	5·15	93·80
"Soycot"	Before	34·66	33·87	6·01	20·95
	After (1)	43·54	40·68	0·65	54·90
	After (2)	43·73	40·35	0·60	57·90
	After (3)	34·44	33·23	5·94	65·80
Soya	Before	47·94	46·35	6·61	5·18
	After (1)	55·44	52·78	4·75	56·10
	After (2)	55·96	55·14	1·54	64·00
	After (3)	47·75	46·40	6·70	9·29

The figures in brackets in the second column indicate the conditions of incubation as set out above.

There is in all cases a rise in the free fatty acid content of the oil, due to the lipases present in the cakes. A clearer idea of the real significance of the changes in composition indicated can be obtained by comparing the absolute weights of each ingredient of the dry matter present before and after incubation. For the samples used in experiments (2) and (3) it was possible, from the data obtained, to calculate these absolute weights and they are given in Table IV.

TABLE IV.

INCUBATION OF MOIST CAKES AT 37°.

Kind of Cake	Before or After Incubation.	Total dry matter. Grams.	Crude Protein. Grams.	True Protein. Grams.	Oil Grams.
Linseed	Before	177·64	58·2	51·1	23·9
	After (2)	176·09	57·8	50·8	19·7
	After (3)	178·48	58·1	50·5	23·9
Ground-nut	Before	182·2	62·1	56·9	20·5
	After (2)	171·1	61·6	58·1	6·7
	After (3)	187·5	61·6	57·6	20·3
Coconut	Before	179·4	37·1	35·7	27·9
	After (2)	176·5	36·7	34·4	27·8
	After (3)	179·6	36·6	36·0	28·1
Palm Kernel	Before	178·9	34·9	33·8	18·6
	After (2)	175·0	34·2	33·7	7·8
	After (3)	180·9	34·7	34·1	18·1
Undecorticated cottonseed	Before	176·1	45·0	41·7	9·4
	After (2)	156·7	44·1	40·6	0·9
	After (3)	177·7	44·4	41·9	9·2
"Soycot"	Before	176·0	61 0	59·6	10·7
	After (2)	151·0	66·0	60·9	0·9
	After (3)	180 1	62·9	59·8	10·7
Soya	Before	175·0	83·9	81·1	11·6
	After (2)	154·1	86·2	84·9	2·4
	After (3)	177·1	84·5	82·2	11·8

It will be seen from these figures that, during the incubation in the presence of toluene (Exp. 3) there was no loss of dry matter, crude protein or oil in any case. Under the conditions of experiment (2) an increase in weight of crude protein is shown by the "soycot" cake to the extent of 5 grams on 61 grams and by the soya cake of about half that amount. The results for these two cakes are quite abnormal in this respect as compared with the other cakes examined. On this account, further samples of cottonseed, "soycot" and soya cakes were obtained from the crushers and 100 gram lots were incubated under the conditions set out in Table V.

In this series there was no development of mould of any of the cakes until the moisture content at the commencement of the incubation exceeded 13 per cent. that is in the sets where the moisture content was made up to 18 per cent. and 21 per cent. respectively. The moulds which developed on the various cakes were examined by Miss K. Sampson, B.Sc., and in all cases species of *Aspergillus* were found, of which the following were identified, *viz*:—*A. Candidus*, *A. Herbariorum*, and *A. niger*, in addition *Mucor racemosus* and *Rhizopus nigricans* were found on the "Soycot" and cottonseed cakes.

TABLE V. INCUBATION OF CAKES WITH VARYING MOISTURE CONTENT.

	After incubation Moisture content at the start				
	Before incubation grams.	As per sample grams	Made to 13 % grams.	Made to 18 % grams.	Made to 21 % grams.
UNDECORTICATED COTTONSEED CAKE.					
Total dry matter ...	89·01	88·24	88·32	84·99	75·55
Oil	·497	5·10	4·80	2·51	0·42
Crude Protein ...	22·56	22·79	22·25	22·62	21·24
Crude Fibre ...	23·10	22·37	22·39	22·39	25·37
Sol. Carbohydrates ...	33·18	32·92	33·10	32·46	23·50
Free fatty acids as % of oleic acid in oil ...	31·75	71·09	81·53	75·76	50·62
"SOYCOT" CAKE.					
Total Dry matter ...	87·19	87·13	86·86	85·19	80·17
Oil	4·95	4·86	4·91	3·50	2·44
Crude Protein ...	30·37	30·40	29·95	30·46	29·91
Crude Fibre ...	12·45	12·52	12·55	12·83	14·24
Sol. carbohydrates ...	33·61	33·40	33·52	32·44	27·74
Free fatty acids as % of oleic acid in oil ...	9·04	17·50	19·26	48·59	49·92
SOYA CAKE.					
Total dry matter ...	89·72	89·00	89·23	77·78	80·68
Oil	5·57	5·62	5·26	1·15	2·21
Crude Protein ...	42·75	41·84	42·49	41·87	42·97
Crude Fibre ...	5·46	5·76	5·56	5·76	5·93
Sol. carbohydrates ...	30·58	30·44	30·60	23·94	24·33
Free fatty acids as % of oleic acid in oil ...	7·86	14·03	14·06	47·94	34·75

The foregoing results obtained with these fresh cakes and the examination of further samples of similar cakes did not confirm the previous results to the increase in the crude protein content of "soycot" and soya cakes during incubation, and it must be concluded therefore that the increases shown in the first case are due to some peculiarity in the particular samples of cake used.

From an examination of the behaviour of cottonseed meal on incubation with varying water content, Konig [5] and Bremer [1] have shown that mould formation first occurred with a water content of 14 per cent., the moulds predominating until the water content exceeded 30 per cent., when the bacteria obtained the upper hand, the mould flora changing with varying water content. They further found that the mould formation was always accompanied by a loss of organic matter, which in the first stages of moulding fell upon the oil fraction, but with a higher water content and the appearance of *Penicillium glaucum*, the N-free extractives were largely consumed. The results given in the Tables IV. and V. are in full accord with these statements. In the first series (Table IV.) a marked loss in dry matter only occurred where there was a development of moulds, namely in the case of the cottonseed, "soycot," soya and ground-nut cakes. In the second series (Table V.) a loss in dry matter is shown only by the two sets of cakes, where the moisture content had been brought up to 18 per cent. and 21 per cent. respectively, and it was only on these sets that there was any mould formation. This loss in dry matter was divided between the oil and the soluble carbohydrates, falling largely on the oil fraction where the moisture content was only 18 per cent.

In order to determine the part played by the oil in the changes which the cake undergo during incubation, portions of the ground cakes were extracted with light petroleum to remove the oil, the residues being dried in a steam oven and then freely exposed to the air for several hours. Portions of 50 grams of each extracted cake were then incubated for three weeks at 37°C., 8 per cent. of water being added to the cakes which had already taken up from 6-10 per cent. of moisture from the air.

TABLE VI.

CAKES EXTRACTED WITH LIGHT PETROLEUM.

Kind of Cake.	Before Incubation.			After Incubation.		
	Total dry matter, grams.	Crude protein, grams.	True protein, grams.	Total dry matter, grams.	Crude protein, grams.	True protein, grams.
Linseed ...	45·20	16·59	14·10	44·70	16·53	13·83
Ground-nut ...	47·80	17·22	15·83	48·00	16·86	16·03
Coconut ...	44·70	10·50	10·03	43·80	10·20	9·64
Palm kernel ...	45·19	9·37	9·26	45·10	9·18	9·11
Undecort. cotton seed	46·67	11·76	11·65	46·20	12·25	11·80
"Soycott" ...	47·06	16·65	15·81	47·06	17·00	15·91
Soya ...	46·95	23·95	23·28	46·37	24·37	23·17

In no case was there any development of mould on the cake or any change in smell noticeable at the end of three weeks, although the cakes had been freely exposed to the air and were incubated under conditions suitable for their re-infection, owing to the presence in the incubator of other samples of cake covered with mould. As will be seen from Table VI there was no change in total dry matter or protein during the incubation. The presence of oil appears, therefore, to be one of the conditions favouring the development of moulds on oil cakes, and the consequent loss of organic matter.

CONCLUSIONS.

1. So far as keeping properties are concerned, palm kernel cake compares favourably with most of the oil-cakes commonly used on the farm.

2. The only change which occurs during storage under ordinary farm conditions is one which is common to all the oil-cakes examined, viz., an increase in the free fatty acid content of the oil.

3. During incubation at 37°, in a moist state, on only four of the cakes examined, namely cottonseed, ground-nut, "soycot" and soya cakes, was there any marked development of moulds.

4. This development of moulds is always accompanied by loss of organic matter, the loss being distributed between the oil and the soluble carbohydrates of the cake.

5. Moulds did not develop, during incubation, on cakes from which the oil had been previously extracted

6. To prevent moulding of cakes and the consequent loss of organic matter, dry storage is essential. Where cakes are stored under very damp conditions serious reduction in their oil-content may take place.

In conclusion I have to thank Professor Crowther for his helpful advice during the progress of the work, and I wish also to thank the Olympia Oil Co., Ltd., Selby; the various branches of the British Oil and Cake Mills, Ltd.; and Messrs. John Curtis & Co., Bristol, for kindly supplying me with the various cakes, used in this enquiry.

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EXPERIMENTS IN TRANSPLANTING COFFEE.

T. B. McCLELLAND.

In Porto Rico, the general practice in transplanting coffee has been to pull, or dig out without any adhering soil, a young tree several feet high with little care as to how many small roots were broken off, and to transplant with no leaf pruning.

In a previous publication, the Porto Rico Experiment Station suggested the advisability of selecting seed from vigorous trees and making nurseries for the production of vigorous seedlings . . . . . .

Coffee seedlings with only 5 to 6 pairs of leaves, when transplanted with the roots incased in a ball of earth from the nursery, show little difference in early growth and yield as a result of transplanting from those transplanted with roots bare of earth, provided the latter transplanting is properly done.

By leaving the seedling in the nursery 1 year longer, that is to say by transplanting them at the time of the second rainy season after sowing, a more even stand may be obtained, since the plants are thriftier and better able to cope with unfavourable conditions. The fact that it is more economical to leave the plants in the nursery than to transplant them, makes it also advisable to adopt this method.

When the seedlings are removed from the nursery to the plantation at approximately 18 to 20 months after the seed has been planted, a considerably earlier growth and increased yield may be expected to result from transplanting the roots incased in a block of soil, rather than with the roots free of soil. This difference should be considerably greater in average planting than in the experiments when care was taken to avoid breaking and drying out the roots. In the 1st experiment, the plants removed with a ball of earth measured at the end of the 1st year 35 per cent. more in height than those transplanted with bare roots; at the end of the 2nd year they were 23 per cent. higher than the check. Their yield the second year was double that of the check. In a 2nd test, the increased growth for the 1st year was nearly 12 per cent. greater, while their yield the 2nd year was 3 times as great. In the 3rd experiment, the increase in height was 43 per cent. greater than that of the check at the end of 2 years, while the crop was more than doubled. The writer therefore recommends the following methods of handling young coffee seedlings: mature seed selected from trees of desirable types may be planted immediately after pulping, or may be washed free of the mucilaginous coating, and kept in an airy shaded place for a period of not longer than 3 or 4 months previous to planting. Excessive drying must be avoided, as this will destroy the viability of the seed . . . . . .

Where the soil is a heavy clay, it is necessary to transplant the seedlings with their roots incased in a ball of the soil. The plant should be so set that in its permanent location it is not deeper than it was in the nursery, with the root collar just below the surface of the soil. A very common practice, and one which is to be condemned, is that of setting a tree in a depression in which the soil gradually accumulates, burying deeply those roots which should remain near the surface and facilitating the entrance of root fungi.—

Bull. Internat. of Agric., September, 1917.

LIBRARY.

A HANDBOOK OF VEGETABLE CULTURE. *

W. MOLEGODE.

The first Edition of this useful little booklet by the Senior Agricultural Instructor of the Ceylon Agricultural Society was issued early in 1916, and such was the local demand that the Edition was rapidly exhausted and steps had to be taken for the issue of a second Edition.

This second Edition appears at an opportune moment when the thoughts of all are directed towards the encouragement of a greater production of food products, vegetables and curry stuffs. It should prove most useful, especially as amendments and additions, based upon further knowledge gathered in the various districts of the Colony, have been made by the author.

The first portion of the booklet is devoted to brief cultural notes on the vegetable products of the Tropics. These notes are arranged in alphabetical order and are thereby of easy reference, and they include hints on the cultivation of the principal curry stuffs which are now being imported in large quantities. These cultural notes are concise and should afford practical assistance to cultivators.

The next portion includes brief notes on seeds, nurseries, seedlings, drainage and irrigation, soils and tillage, while special emphasis is laid upon manures and fertilizers, and the formulæ for special fertilizing mixtures for certain garden crops are provided.

The concluding portion of the booklet gives information as to those particular varieties of garden crops which have proved the most popular amongst the gardeners of the Colony. This information should prove to be of assistance and guidance to those who desire to order seeds from abroad. A concluding chapter has been added on the insect pests and fungus diseases that affect vegetable crops. This gives in general outline information required by the grower and makes suggestions as to possible measures for control.

The Colony is capable of producing larger quantities of food products, vegetables and curry stuffs. Every endeavour is being made to encourage this greater production, and the present volume can be recommended to those that desire to endeavour to assist in this direction. The time for the South-West Monsoon planting is rapidly approaching and all cultivators should begin to make their plans and preparations. There is increasing evidence of the greater cultivation of food products, and with the restriction of work with plumbago, rubber and other products many cultivators are making plans for growing food crops for consumption and for sale. Estate and mine owners can assist to encourage this work and might find useful suggestions in the above booklet which is based largely upon local knowledge and experience.

* A Handbook of Vegetable Culture by W. Molegode, Senior Agricultural Instructor, Ceylon Agricultural Society. Published by Times of Ceylon Company, Limited, Colombo. Price Rs. 2·00.

CROSS-BREEDING FOR INCREASED PRODUCTION, TOMATOS AND CUCUMBERS.

It is a well-established fact that in certain plants—Maize, for example—hybrids produced by cross-fertilisation show a marked superiority in productiveness over the parents between which the cross was made.

Hence the suggestion has often been made that it should be possible in the case of food plants which are habitually self-fertilised and are easily cross-fertilised by artificial means, to raise seed each year by cross-artificial fertilisation, and thereby obtain first generation hybrids which would repay the trouble by their extra yield.

One of the plants which lends itself readily to experimentation along these lines is the Tomato. It is self-fertile, and yet can be easily crossed by artificial means. In ordinary conditions of cultivation it is almost, but not quite, always self-fertilised. In the open, at all events, occasional crosses occur. Hence it might be supposed that this plant, grown year after year from self-fertilised seed, might be all the better for occasional or regular crossing. Against this idea, however, is the striking fact that the yield from the best varieties of Tomato is already remarkably high. It is, for example not uncommon for Tomatos grown under glass in the Lea Valley and elsewhere to yield so much as 40 tons to the acre, and this amount is said to be exceeded occasionally.

It spite of the apparent improbability of obtaining yet higher yields, it is most desirable that the question should be answered by the authoritative method of experiment. Trials made at the beginning of the war at Wisley, where the varieties Sunrise and Merivale were crossed with one another, gave only negative results. The hybrid was as good as either parent, but no better so far as yield was concerned. Unfortunately, the trials had to be broken off owing to the exigencies of the war. In the meantime the subject has been taken up independently by Messrs. Hayes and Jones* with results which cannot fail to be of interest to the tomato grower.

As a preliminary the yiel 's resulting from self-fertilised seed of selected varieties were ascertained over a period of several years, and it was found that self-fertilisation during three or four years caused no noteworthy diminution of yield. All that happened was that a number of types was isolated, some of which were of higher—and some of lower-yielding capacity. In other words, self-fertilisation gives an opportunity to the grower to select seed from the higher yielding strains. This, of course, is what good growers already do. But, in spite of the fact that there was no falling-off in yield in self-fertilised strains, it was ascertained experimentally that in the case of some varieties the result of cross-fertilisation was to produce a definite superiority of yield over either parent. Thus in the case of the Cross Stone and Dwarf Champion the first generation hybrid gave a regular 8 per cent. over the parental average. This, in terms of yield per acre, would mean an extra ton and upwards—to be obtained at the very slight expenditure of time

* *The Effect of Cross-and Self-Fertilisation in Tomatos.* Report of the Connecticut Agric. Exp. Station, New Haven, Conn.

and trouble required for the work of artificial fertilisation. That operation is of the simplest. When the plants are growing under glass the chance of accidental fertilisation may be ignored. All that is required is that the ring of stamens should be lifted off before they burst. This may be done with the point of a penknife. Pollen from the other parent should be dusted in the stigma of the emasculated flowers which are marked by a coloured thread and left to set their fruits. If absolute certainty is required, the emasculated flower may be covered with a paper bag so as to prevent any pollen—other than that of the variety chosen as the male parent—from reaching the stigma. In Messrs. Hayes and Jones' experiments with the two varieties already named (Stone and Dwarf Champion), not only did the first generation hybrid show an 8 per cent increase in weight over the parental average, but it also produced about the same number of fruits as the better parent, so that producing as many, or nearly as many, fruits as the one parent, and as heavy, or nearly as heavy, fruits as the other parent, the superiority of the first generation hybrid over the better parent was not 8 but 15 per cent. In the course of the four years during which the experiment was conducted the superiority of the hybrid ranged from 11 to 17 per cent.

It must be borne in mind that the hybrid seed must be raised artificially each year, for hybrid vigour only manifests itself to the full in the first generation.

It is also to be remembered that it is not to be expected that any two varieties mated together will inevitably produce so good a result as that yielded by Stone and Dwarf Champion. Thus the authors found that when Lorillard and Best of All were crossed together the hybrid gave no higher yield than that given by the better parent.

No less interesting, and possibly of greater practical importance is the observation by Messrs. Hayes and Jones that when two varieties of tomatos differing with respect to earliness are crossed with one another, the first generation hybrid is earlier than either parent, whereas in the actual experiment the earlier of the parent varieties (Dwarf Champion) produced 55 per cent. of its crop by a given date, the first generation hybrid produced 59 per cent. of its crop by that date. The importance of a market gardener being able to modify in this way the time at which his produce is marketable is self-evident. As the authors point out, the vigour imparted to the hybrid as a result of crossing differs from vigour induced by specially favourable external conditions; for whereas the latter tends to prolong the vegetative and delay the fruiting stage, hybrid vigour hastens the stage of fruit formation.

Messrs. Hayes and Jones have also extended their experiments to Cucumbers, with similar results. The varieties used for the purpose were: Early Russian, White Spine, London Long Green, and Fordhook Famous. In all the crosses the first generation hybrid exceeded the more prolific parent by an average of from 1-6 to 8 fruits per plant—that is, from 6-27 per cent. The smallest result was obtained from the cross London Long Green and Fordhook Famous, which two varieties are of very similar habit and character. Where, as was the case in the other crosses, the parents differed markedly from one another, the hybrid vigour of the first generation was pronounced.—The Gardeners' Chronicle, Vol. lxii, No 1618.

ANIMAL DISEASE RETURN FOR THE MONTH ENDED 31st MARCH, 1918.

Province.	Disease	No. of cases to date since Jan. 1st, 1918.	Fresh cases	Recoveries.	Deaths.	Balance ill.	No. shot.
Western	Rinderpest	25	5	8	17	—	—
	Foot & mouth disease	14	11	14	—	—	—
	Anthrax	2	—	—	2	—	—
	Swine Plague	30	30	—	30	—	—
Colombo Municipality	Rinderpest	9	—	—	—	—	—
	Foot & mouth disease	22	—	—	—	—	—
	Anthrax	1	—	—	—	—	—
	Rabies	2	1	—	—	—	—
Quarantine Station	Anthrax	667	324	—	—	—	—
Central ...	Foot & mouth disease	68	4	37	1	30	—
Northern	—	—	—	—	—	—	—
North-Western	Rinderpest	8	—	3	5	—	—
	Foot & mouth disease	9	2	9	—	—	—
Eastern	Foot & mouth disease	183	5	163	20	—	—
Sabaragamuwa	—	—	—	—	—	—	—
Uva	Foot & mouth disease	8	—	8	—	—	—
North-Central	Foot & mouth disease	3139	1994	2996	45	98	—
Southern	Black-quarter	11	—	—	11	—	—

G. W. STURGESS, G.V.S.

METEOROLOGICAL.

MARCH, 1918.

Station.	Temperature: Mean Daily Shade	Temperature: Difference from average	Mean Humidity	Mean amount of cloud 0=clear. 10=Overcast	Mean Wind direction during month	Daily mean Velocity	Rainfall: Amount	Rainfall: No. of Rainy days	Rainfall: Difference from average
	°	°	%			Miles	Inches		Inches
Colombo Observatory	80·8	-0·6	78	4·2	W	86	1·85	6	-2·59
Puttalam	80·9	-0·3	77	3·2	Variable	109	2·28	5	-0·61
Mannar	82·6	-0·3	70	3·5	Variable	135	0·34	1	-1·02
Jaffna	81·6	-1·3	73	2·7	E	132	0·05	2	-0·89
Trinco'mee	81·8	-0·7	75	4·6	E	133	0·15	2	-1·39
Batticaloa	80·4	-0·4	78	4·4	E	157	1·66	8	-1·39
Hambantota	79·4	-1·0	80	4·1	E	273	3·26	7	+1·13
Galle	80·6	-0·6	78	5·0	Variable	96	1·32	10	-2·89
Ratnapura	82·0	-0·2	71	4·8	—	—	11·37	20	+3·03
Anu'pura	82·0	0	66	6·0	—	—	4·89	8	+2·32
Kurunegala	82·2	-0·9	66	4·7	—	—	3·31	10	-1·37
Kandy	78·5	+0·1	64	4·8	—	—	4·91	9	+1·21
Badulla	73·4	+0·2	72	5·4	—	—	4·30	12	-0·01
Diyatalawa	66·6	-1·4	71	5·8	—	—	5·48	10	+1·26
Hakgala	59·2	-1·1	80	6·4	—	—	11·55	17	+6·53
N'Eliya	58·5	-0·7	75	6·2	—	—	6·71	12	+2·49

During the month, thunderstorms resulted in rainfall slightly heavier than usual being experienced Inland. In the greater part of the low country the rainfall was below normal.

As would be expected, the cloud amount and the number of rainy days was above that of the average inland and below near the coast.

The temperature was mostly slightly below normal.

In direction and force, the wind was about normal.

J. E. EVANS,
Acting Supdt., Observatory.

MARKET RATES FOR TROPICAL PRODUCTS.

(From Lewis & Peat's Latest Monthly Prices Current.)

	QUALITY.	Quotations.
ALOES, Soccotrine cwt.	Fair to fine	110/ a 120/
Zanzibar & Hepatic "	Common to good	40/ a 105/
ARROWROOT (Natal) lb.	Fair to fine	9d a 9½d
BEES' WAX cwt.		
Zanzibar Yellow "	Slightly drossy to good	£9 a £9 5/ nom.
East Indian bleached "	Fair to good	£11 12/6 a £12 "
" unbleached "	Dark to good genuine	£8 15/ a £9 "
Madagascar "	Dark to good palish	£9 a £9 7/6 "
CAMPHOR, Japan lb.	Refined	3/10 a 4/3
China cwt.	Fair average quality	Nominal
CARDAMOMS, Tuticorin	Good to fine bold	3/6 a 4/6 nom.
per lb.	Middling lean	2/ a 2/9 "
Malabar, Tellicherry "	Good to fine bold	3/ a 4/ "
Calicut "	Brownish	1/9 a 2/6 "
Mangalore "	Med Brown to good bold	2/6 a 5/3 "
Ceylon, Mysore "	Small fair to fine plump	2/ a 5/
Malabar "	Fair to good	1/7 a 1/8
Seeds, E. I. & Ceylon "	Fair to good	2/3 a 2/6
Ceylon "Long Wild" "	Shelly to good	1/ a 1/6 nom
CHILLIES, Zanzibar cwt.	Dull to fine bright	75/ a 85/
Japan "	Fair bright small	60/ a 70/
CINCHONA BARK.—lb.	Crown, Renewed	3⅜d a 7d
Ceylon	Org. Stem	2d a 6d
	Red Org. Stem	1¾d a 4¼d
	Renewed	3d a 5½d
	Root	1½d a 4d
CINNAMON, Ceylon 1sts.	Fair	2/6
per lb. 2nds.	" "	2/3
3rds.	" "	2/
4ths.	" "	11d
Chips.	Fair to fine bold	10½d a 1/
CLOVES, Penang lb.	Dull to fine bright pkd.	3/6 a 4/
Amboyna "	Dull to fine	2/ a 2/6
Zanzibar "	Fair and fine bright	1/9 a 2/
Madagascar "	Fair	1/9 a 1/10
Stems "	Fair	7½d
COFFEE		
Ceylon Plantation cwt.	Medium to bold	Nominal
Liberian "	Fair to bold	"
COCOA, Ceylon Plant. "	Special Marks	87/ a 95/
	Red to good	80/ a 88/
Native Estate	Ordinary to red	50/ a 83/
Java "	Small to good red	70/ a 100/
COLOMBO ROOT "	Middling to good	160/ a 170/
CROTON SEEDS, sifted "	Dull to fair	70/ a 75/
CUBEBS "	Ord. stalky to good	£16/ a £17/ 10/
FIBRE, Kitul lb.	OOO good long	10d a 11d [nom.
	OO " medium	8½d
	No. 1 fair	7d
Palmyrah ton.	Common to fair	£30/ a £35 nom.
"	Medium to good med	£40/ a £45 "
	Good to fine	£50/ a £60 "
GINGER, Bengal, rough cwt.	Fair	62/6
Calicut, Cut A "	Medium to fine bold	100/ a 110/
B & C "	Small and medium	90/ a 100/
Cochin, Rough "	Common to fine bold	67/6 a 72/6
	Small and D's	67/6
Japan "	Unsplit	52/6 a 55/
GUM Ammoniacum "	Ord. blocky to fair clean	175/ a 200
Animi, Zanzibar	Pale and amber, str. srts	£14 10/ a £16 10/
"	" " little red	£11 a £12
"	Bean and Pea size ditto	70/ a £11
"	Fair to good red sorts	£8 10/ a £10 10/
"	Med. and bold glassy sorts	£5 10/ a £7 5/
Madagascar "	Fair to good palish	£4 a £8
" " red		£4 a £7
Arabic, E. I. & Aden "	Ordinary to good pale	55/ a 75/
Turkey sorts "	... ...	85/ a 87/6
Ghatti "	Sorts to fine pale	30/ a 50/
Kurrachee "	Reddish to good pale	35/ a 50/ nom.
Madras "	Dark to fine pale	30/ a 45/ nom.
Assafœtida "	Clean fr. to gd. almonds	£15 a £20
	com. stony to good block	£4 a £10
INDIGO, E.I. Bengal lb.	Shipping mid to gd. violet	10/ a 12/6
"	Consuming mid. to gd.	9/ a 10/
"	Ordinary to middling	7/6 a 9/
"	Mid. to fine Kurpah	7/ a 9/
"	Low to ordinary	4/6 a 6/9
"	Mid. to fine Madras	2/6 a 4/6
KAPOK lb.	Ordinary to good	1/ a 1/4
KINO lb.	Fair to fine bright	6d a 1/5
MYRRH, Aden sorts cwt.	Middling to good	190/ a 210/
Somali "	" "	160/ a 180/
MACE, Bombay & Penang		
per lb.	Pale reddish to fine	3/6 a 4/
	Ordinary to fair	3/ a 3/6
Java	" " good pale	3/3 a 4/
Bombay	Wild	8d

	QUALITY.	Quotations.
NUTMEGS,— lb.		
Singapore & Penang "	64's to 57's	2/ a 2/6
	80's	1/11
	110's	1/6
NUX VOMICA, Cochin	Ordinary to good	42/6 a 45/
per cwt. Bengal		40/ a 42/
Madras	" "	40/ a 43/
OIL OF ANISEED lb.	Fair merchantable	4/2
CASSIA "	According to analysis	6/ a 6/6
LEMONGRASS oz.	Good flavour & colour	4⅜d
NUTMEG "	Dingy to white	1½d a 1¾d
CINNAMON (Ceylon)	Ordinary to fair sweet	6d a 2s 6d
CITRONELLE " lb.	Bright & good flavour	2/8
OLIBANUM, drop cwt	Good to fine white	130/ a 150/
"	Middling to fair	100/ a 120
pickings "	Low to good pale	22/6 a 40/
siftings "	Slightly foul to fine	35/ a 45/
ORCHELLA WEED—cwt		
Ceylon "	Fair	10/6
Madagascar "	Fair	10/6
Zanzibar "	Fair	10/6
PEPPER—(Black) lb.		
Alleppy & Tellicherry	Fair	1/3 a 1/3½
Ceylon " "	Fair to fine bold heavy	1/2 a 1/4
Singapore ...	Fair	1/2
Acheen & W. C. Penang	Dull to fine	1/2
(White) Singapore "	Fair to fine	1/7 a 1/7½
Siam "	Fair	1/8¼
Penang "	Fair	none
Muntok "	Fair	1/8½
RHUBARB, Shenzi "	Ordinary to good	1/8 a 3/
Canton "	Ordinary to good	1/6 a 2/6
High Dried "	Fair to fine flat	2/ a 2/3
RUBBER, INDIA lb.	Standard smoked sheets	2/3½
Ceylon, Straits, "	Standard Crepe	2/4½
Malay Straits, etc. "	Scrap fair to fine	1/9½
Assam "	Fair 11 to ord. red No. 1.	1/4
Rangoon "	" " "	1/6
Borneo "	Common to good	1/6
Java "	Good to fine red	1/8 a 1/10
Penang "	Low white to prime red	1/6 a 1/9
Mozambique "	Sausage, fair to good	1/6 a 2/
Nyassaland "	Fair to fine ball	1/6 a 2/
Madagascar "	Fr. to fine pinky & white	1/4 a 1/7
"	Majunga & blk coated	1/
"	Niggers, low to good	9d a 1/6
New Guinea "	Ordinary to fine ball	1/6 a 2/
SAGO, PEARL, large—cwt	Fair to fine	65/ a 70/
medium ...	" "	65/ a 70/
small ...	" "	65/ a 70/
Flour ...	Good pinky to white	75 a 77/6
SEEDLAC cwt.	Ordinary to gd. soluble	225/ a 250/ nom.
SENNA, Tinnevelly lb.	Good to fine bold green	9d a 10d
	Fair greenish	5½d a 8d
	Common specky & small	3d a 4½d
SHELLS, M. of PEARL—		
Egyptian cwt.	Small to bold	40/ a £5 10/ nom
Bombay "	" "	55/ a £5 15/ "
Mergui "	Chicken to bold	£6 15/ a £14 "
Manilla "	" "	£6 a £10/ nom
Banda "	Sorts	40/ a 45/ "
Green Snail "	Small to large	50/ a 75/ "
TAMARINDS, Calcutta...	Mid to fine bl'k not stony	45/ a 50/
per cwt. Madras	Inferior to good	25/ a 35/
TORTOISE SHELL—		
Zanzibar & Bombay lb.	Small to bold	10/ a 25/
	Pickings	5/ a 15/
Ceylon	Small to bold	10/ a 22/
Mauritius & Seychelles	" "	10/ a 25/
TURMERIC, Bengal cwt.	Fair	50/
Madras "	Finger fair to fine bold	60/ a 65/
Do. "	Bulbs " " [bright	45/ nom.
Cochin "	Finger fair	50/ nom.
	Bulbs "	37/6
VANILLA,— lb.		
Mauritius ... } 1sts.	Gd. crystallized 3½a 8½ in.	5/6 a 9/6
Madagascar ... } 2nds.	Foxy & reddish 3½a "	5/ a 7/
Seychelles ... } 3rds	Lean and inferior	5/ a 5/9
WAX, Japan, squares, cwt.	Good white hard	102/5

The Tropical Agriculturist:

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The **Tropical Agriculturist** occupies the leading place amongst British journals dealing with tropical agriculture. Articles on all branches of the tropical agricultural industries are included. Special reference is given to tea, rubber, cacao, coconuts, rice and other products of Ceylon, and extracts from other agricultural journals and magazines are included. Important articles are given on the co-operative credit society movement.

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